Supreme Court, U.S.
FILED
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CLERK

No. 97-288

In The

Supreme Court of the United States

October Term, 1997

VICKY LEWIS and GARY LEWIS, individually, as parents, as next friends and as administrator of the estate of KATHRYN C. LEWIS,

Petitioners,

v.

BRUNSWICK CORP.,

Respondent.

On Writ Of Certiorari To The United States Court Of Appeals For The Eleventh Circuit

JOINT APPENDIX

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Petition For Writ Of Certiorari Filed: August 13, 1997
Writ Of Certiorari Granted: November 14, 1997

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TABLE OF CONTENTS

		Page
1.	District Court Docket Entries	1
2.	Eleventh Circuit Docket Entries	3
3.	Complaint	4
4.	Answer	14
5.	Joint Stipulation of Facts with Exhibits Thereto	29
	a. Exhibit 1 – Copy of letter from R.C. Hill, Chief, State Liaison and Compliance Division of the United States Coast Guard, to Mr. Orrin Lahman, Commissioner, New York State Parks and Recreation Authority, dated December 22, 1975	37
	b. Exhibit 2 – Copy of a Memorandum from A.T. Miles, Chief, Operator Compliance Branch of the United States Coast Guard, to Chief, State Liaison and Compliance Division of the United States Coast Guard, dated August 18, 1976	39
	c. Exhibit 3 – Copy of letter from O.W. Siler, Admiral, United States Coast Guard Commandant, to Mr. William Brey, Chief, Division of Law Enforcement, Illinois Department of Conservation, dated January 12, 1997	41
	d. Exhibit 4 – Copy of a Memorandum from G.H. Patrick Bursley, Chief Counsel, United States Coast Guard, to Chief, Office of Boating Safety of the United States Coast Guard, dated July 13, 1977	44

TABLE OF AUTHORITIES – Continued

Page

e. Exhibit 5 – Copy of the "Report of the Propeller Guard Subcommittee of the National Boating Safety Advisory Counsel," including all attachments thereto, dated November 7, 1989 46

f. Exhibit 6 – Copy of the Minutes of the National Boating Safety Advisory Counsel, Report of the Committee on Propeller Guards, dated November 6-7, 1989 103

g. Exhibit 7 – Copy of a letter from Robert T. Nelson, Rear Admiral, United States Coast Guard, Chief, Office of Navigation and Waterway Services, to Mr. A. Newell Garden, Chairman, National Boating Safety Advisory Counsel, dated February 1, 1990..... 163

h. Exhibit 8 – Copy of an article titled "Motorboat Propeller Injuries" prepared by Jon S. Vernick and Associates, The Johns Hopkins University Injury Prevention Center and Institute for Injury Reduction, dated September 1992..... 168

6. Decision Under Review: printed in *Petition for Writ of Certiorari*.....A1-A25

RELEVANT DOCKET ENTRIES

U.S. District Court
Southern District of Georgia (Augusta)

7/3/95	1	NOTICE OF REMOVAL by dft from the Superior Ct of Columbia Co, GA, to include cys of sheriff's entry of service, summons, complaint, ans of Brunswick, and ntc of filing; FILING FEE $ 120.00 receipt # 161742 (sda) [Entry date 07/07/95]
10/13/95	5	JOINT STIPULATION OF FACTS by plffs and dft (sda) [Entry date 10/16/95]
10/31/95	7	MOTION by Brunswick Corp. for Summary Judgment with brief in support. (sda) [Entry date 11/01/95]
10/31/95	8	MEMORANDUM of law by Brunswick Corp. in support of [7-1] motion for Summary Judgment by Brunswick Corp. (sda) [Entry date 11/01/95]
10/31/95	9	STATEMENT OF MATERIAL FACTS by defendant Brunswick Corp. in support of [7-1] motion for Summary Judgment by Brunswick Corp. (sda) [Entry date 11/01/95]
11/20/95	11	BRIEF/MEMORANDUM by Vicky Lewis, Gary Lewis in opposition to [7-1] motion for Summary Judgment by Brunswick Corp. (sda) [Entry date 11/21/95]
12/12/95	16	REPLY/RESPONSE by defendant Brunswick Corp. to plffs' [11-1] opposition brief/memorandum to dft's motion for summary jugmt (sda)

12/13/95	17	NOTICE OF FILING of supplemental authority by Vicky Lewis, Gary Lewis in opposition to summary judgment (sda)
1/22/96	18	ORDER granting dft's [7-1] motion for Summary Judgment; clerk instructed to close case and enter final judgment in favor of dft, taxing costs against plffs; (signed by Judge Dudley H. Bowen Jr.); copies served (sda) [Entry date 01/23/96]
1/22/96	19	JUDGMENT for Brunswick Corp. in accordance with Order of Ct entered 1/22/96, granting dft's motion for summary jgmt; costs shall be assessed agnst plffs and taxed by Clerk of Ct; copies served. (sda) [Entry date 01/23/96]
1/29/96	20	NOTICE OF APPEAL by Vicky Lewis, Gary Lewis to the US Ct of App. 11th Cir, from order granting dft's mot for sum jgmt entered on 1/22/96. FILING FEE $105; RECEIPT # 166770; copies served; [19-1] judgment order, [18-1] order (sda) [Entry date 01/30/96]

ELEVENTH CIRCUIT

8. OPINION INFORMATION – Pub XXX NonPub ___

3/21/97 Opinion Issued

[X] Affirmed [EEC] Signed

10. REHEARING INFORMATION

4/11/97 Petition for Rehearing (J) 4/14/97

Apt X Ape _ Panel X En Banc X

5/15/97 Order Denying Rehearing

IN THE SUPERIOR COURT OF COLUMBIA COUNTY
STATE OF GEORGIA

VICKY LEWIS AND GARY LEWIS, individually, as parents, as nest friends and as administrator of the estate of KATHRYN C. LEWIS,	)	Civil Action File No. CV95-277
Plaintiffs,	)	COMPLAINT FOR DAMAGES
v.	)	
BRUNSWICK CORP.,	)	(Filed June 2, 1995)
Defendant.	)	

NOW COME Vicky Lewis and Gary Lewis, as individuals, parents, next friends and administrator of the estate of Kathryn C. Lewis (hereinafter "Kathee Lewis"), deceased, and shows the following in support of their Complaint for damages:

THE PARTIES

1. Gary and Vicky Lewis are residents of Healdton, Oklahoma, and are the parents of Kathee Lewis. Vicky Lewis is also the duly appointed administrator of the Estate of Kathee Lewis.

2. Defendant Brunswick Corp. is a Delaware corporation registered to do business in Georgia. The registered agent for Defendant Brunswick Corp. is C.T. Corporations System, 1201 Peachtree Street, N.E., Atlanta, Georgia 30361, and Defendant Brunswick Corp. may be served with legal process through said agent at said address.

3. Defendant Brunswick Corp. has in the past and still does engage in a continuous, systematic and substantial course of doing business in Georgia, including the sale of its outboard and other boat and marine products through authorized dealers and dealerships located throughout Georgia and Columbia County.

4. Jurisdiction and venue are properly laid in this Court under the Georgia Long-Arm Statute.

OPERATIVE FACTS

5. On June 6, 1993, at approximately 4:36 p.m., Kathee Lewis was a passenger in a motorized boat in Columbia County, Georgia.

6. The area, place and location at which Kathee Lewis and her friends were boating was a place normally, frequently, and customarily used by water-skiers and boaters for leisure, water-time recreational activities.

7. On the date and at the time and place stated above, Ralph Coffman was operating a 17 foot 5 inch fiberglass hull open motor boat which was powered by a 75 horsepower Mariner outboard engine manufactured by the Defendant Brunswick Corp. in 1987.

8. Kathee Lewis was ejected from the boat into the water when the boat struck wake, and Kathee came in contact with the rapidly rotating propeller blades on the outboard motor manufactured by Defendant Brunswick Corp.

9. The rotating propeller blades repeatedly struck Kathee Lewis on her body, causing numerous severe lacerations and extensive chop wounds to the head, face, neck, upper extremity and lower extremity of the body from which she died.

10. Kathee Lewis was pronounced dead at the scene by the Columbia County Coroner. She was 19 years old, and died without leaving a child or spouse.

COUNT I

11. Defendant Brunswick Corp. is a manufacturer and merchant seller of marine products, including outboard motors, and it was the manufacturer and merchant seller of the above-stated outboard motor used to power the boat, the propeller of which struck and killed the decedent Kathee Lewis.

12. It is averred that for several years prior to the date on which Defendant Brunswick Corp. designed, manufactured, assembled and sold the above-stated outboard motor it knew that it was foreseeable and inevitable that swimmers, water-skiers, and other persons lawfully and properly in, or accidentally ejected into, the waters near pleasure craft would be struck and either severely injured or killed by rotating propeller blades on outboard motors manufacturer, designed, assembled, and sold by the Defendant Brunswick Corp.

13. It is averred that for several years prior to the date on which it designed, manufactured, assembled, and sold said outboard motor, Defendant Brunswick Corp. had the expertise, experience, trained engineering staff, and economic ability to design and install on outboard motors manufactured by it a technologically feasible people-protective propeller guard, ring, shroud, nozzle, or other device which was capable of preventing the rotating propeller blades from striking swimmers, water-skiers, and other innocent persons lawfully and properly in the water or accidentally thrown into the water in a manner similar to that of decedent Kathee Lewis in this case.

14. It is averred that a properly designed propeller guard of the kind referred to above would have substantially reduced or eliminated the severe injuries sustained by decedent Kathee Lewis in the above-stated accident, would have saved her life, and would have caused only minor, non-life-threatening injuries.

15. Kathee Lewis sustained enhanced injuries, this is, her death, as a direct and proximate result of the absence of said propeller guard.

16. It is further averred that Defendant Brunswick Corp. for several years prior to the date on which it designed, assembled, manufactured, and sold the outboard motor in question, had the experience, expertise, trained engineering staff, and economic ability to design and install a technologically feasible people-protective propeller guard, ring shroud, nozzle, or other device which would not only substantially reduce the risk of injury and death, but could do so at minimal cost and without substantially impairing the hydro-dynamic performance characteristics or usefulness of the outboard motors to perform their intended functions.

17. It is averred that Defendant Brunswick Corp. acting by and through its agents and employees, all of whom were acting within the course and scope of their employment for Defendant Brunswick Corp. were negligent and that its negligence consisted of the following:

    a. failing to design, assemble, manufacture, and install a propeller guard, ring, shroud, nozzle, or other device on the outboard motor manufactured and sold by it so as to prevent the rotating propeller blades on said outboard motor from striking decedent Kathee Lewis;

b. failing to give due, adequate, and proper regard to the rights and position of decedent Kathee Lewis, Vicky Lewis and Gary Lewis as stated herein;

c. failing to recall outboard motors manufactured by it and not producing a propeller guard of the kind referred to above;

d. making a conscious design decision to manufacture and market an unreasonable dangerous product, to wit, outboard motors with unprotected propellers, when it knew that said unprotected propellers were causing serious injuries and death, and when it further knew that such injuries could be avoided and prevented by use of a propeller guard; and

e. making a conscious design decision to manufacture and market an unreasonably dangerous product, to wit, outboard motors with unprotected propellers, because installation of people-protective propeller guards might interfere with Defendant Brunswick Corp,'s profits resulting from the sale of replacement propellers as well as potentially interfere with the sale of larger, more expensive, and faster motors.

18. As a direct and proximate result of the negligence of Defendant Brunswick Corp. as referred to above, decedent Kathee Lewis sustained enhanced injuries which she would not otherwise have sustained in the accident in question but for the negligence of the Defendant Brunswick Corp. in failing to incorporate a people-protective propeller guard into the design of its outboard motors, which enhanced injuries directly and proximately caused decedent Kathee Lewis' death.

19. As a direct and proximate result of the negligent conduct of Defendant Brunswick Corp. as referred to above, decedent Kathee Lewis suffered severe, excruciating, and unrelentingly painful injuries on June 6, 1993, from which she died as a result thereof.

20. Vicky Lewis and Gary Lewis, as parents, as next friends, individually and as executor of the estate of decedent Kathee Lewis, are entitled to recover the full value of the life of their deceased daughter Kathee Lewis under the Georgia Wrongful Death Act, O.C.G.A. § 51-4-4.

21. By reason of the death of decedent Kathee Lewis, Vicky and Gary Lewis have suffered substantial pecuniary losses including (but not limited to) the loss of contributions, service, aid, association, support, protection, comfort, care, and society, as well as funeral expenses, by reason of her death.

22. Defendant Brunswick Corp. is liable to Vicky and Gary Lewis under the Georgia Wrongful Death Act for the full value of the life of Kathee Lewis, which was tragically and abruptly shortened due to the negligence and defective product of Defendant Brunswick Corp. as set forth herein. The amount of this liability is to be determined by the enlightened conscience of an impartial jury.

COUNT II

23. Plaintiffs incorporate by reference hereto all of the allegations of Paragraphs 1 through 22 of this Complaint as if set forth fully herein.

24. As a direct and proximate result of the negligent and tortious conduct of Defendant Brunswick Corp. as referred to above, decedent Kathee Lewis sustained

severe, unrelenting, and excruciatingly painful injuries which caused her great conscious pain and suffering and resulted in her death on June 6, 1993.

25. As a further direct and proximate result of the negligent and tortious conduct of Defendant Brunswick Corp. as referred to above, decedent Kathee Lewis has been deprived of the gross earnings which she would have made from the date of her injury throughout the balance of her estimated working life expectancy.

26. Defendant Brunswick Corp. is liable to Vicky and Gary Lewis for all damages sustained by the estate of Kathee Lewis, including damages for her unrelenting and excruciating conscious pain and suffering, and loss of gross earnings over the rest of her working life expectancy in an amount to be determined by the enlightened conscience of an impartial jury.

COUNT III

27. Plaintiffs incorporate by reference hereto all of the allegations contained in Paragraphs 1 through 26 of this Complaint as if set forth fully herein.

28. It is averred that the conduct of Defendant Brunswick Corp. acting by and through its agents and employees, and within the scope of its authority, was willful, malicious, intentional, or alternatively, grossly reckless and negligent, and in callous disregard of the outcome and consequences of such action in that:

    a. Defendant Brunswick Corp. for many years prior to the date of the accident in this case, had the knowledge to design into its outboard motor systems a technologically feasible and not costly people-protective propeller-guard system which

would reduce the harm from foreseeable propeller injuries but chose instead to consciously disregard such technology in order to enhance its profits in marketing and merchandising of its motors and accessory parts, including its replacement propellers and motors, without such people-protective devices;

    b. Defendant Brunswick Corp. has engaged in wrongful conduct intended to suppress the production and availability of guards built by third persons; and

    c. Defendant Brunswick Corp. has falsely and fraudulently exaggerated performance differences between a boat and motor with and without a propeller guard.

29. It is averred that the conduct of Defendant as set forth above has been carried out in an attempt to suppress the availability of methods for preventing propeller injuries in order to protect its product liability exposure, all in conscious disregard of the welfare of members of the public engaged in boating and recreational water activity.

30. Vicky and Gary Lewis demand punitive damages against Defendant Brunswick Corp. on this Count III of the Complaint for such sum as an enlightened and impartial jury finds will adequately punish Defendant Brunswick Corp. and serve as a deterrent to others who would commit similar acts in the future.

COUNT IV

31. Plaintiffs incorporate by reference hereto all of the allegations of Paragraphs 1 through 30 of this Complaint as if set forth fully herein.

32. Defendant Brunswick Corp. designed, manufactured, assembled, and sold a defective and defectively designed product which was unreasonably dangerous and which was a substantial factor in causing enhanced injuries to the decedent Kathee Lewis, to wit, her death, which could have been avoided with only minor, non-life-threatening, non-disabling injuries being sustained by her if a people-protective propeller guard had been designed into the product in question.

33. Vicky and Gary Lewis demand judgment against Defendant Brunswick Corp. in a sum to be determined by the enlightened conscience of an impartial jury which will serve as adequate compensation for the above-stated loss and damages resulting from the defective product manufactured and marketed by Defendant Brunswick Corp.

WHEREFORE Plaintiffs Vicky Lewis and Gary Lewis, individually, as parents, as next friends and as administrator of the estate of Kathryn C. Lewis pray as follows:

a. That this Complaint be served on Defendant Brunswick Corp. as provided by law;

b. That Vicky and Gary Lewis recover from Defendant Brunswick Corp. the full value of the life of Kathee Lewis, including but not limited to the loss of Kathee Lewis' gross earnings over the rest of her working life expectancy (reduced to present value);

c. That Vicky and Gary Lewis recover from Defendant Brunswick Corp. damages for the pain and suffering inflicted upon Kathee Lewis;

d. That Vicky and Gary Lewis recover from Defendant Brunswick Corp. all other damages caused by the defective product manufactured and sold

by Defendant Brunswick Corp. and the negligence of Defendant Brunswick Corp.;

e. That Vicky and Gary Lewis recover from Defendant Brunswick Corp. punitive damages to deter Defendant Brunswick Corp. and others from committing similar wrongs; and

f. That this Court order such other relief as it deems fit, just and proper.

This 2nd day of June, 1995.

David E. Hudson
William J. Keogh, III

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R. Ben Hogan, III

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Birmingham, Alabama 35203-3758

By: /s/ David E. Hudson
Attorneys for Plaintiff

IN THE SUPERIOR COURT OF COLUMBIA COUNTY
STATE OF GEORGIA

VICKY LEWIS and GARY LEWIS, Individually, as Parents, as Next Friends, and as Administrator of the Estate of Kathryn C. Lewis,	)	
Plaintiffs,	)	CIVIL ACTION
v.	)	FILE NO. CV95-277
BRUNSWICK CORP.,	)	
Defendant.	)	

ANSWER OF BRUNSWICK CORPORATION

COMES NOW Brunswick Corporation ("Brunswick"), Defendant in the above-captioned action, and for its Answer to Plaintiffs' Complaint, states as follows:

FIRST DEFENSE

Neither Plaintiffs' Complaint as a whole nor any part thereof states a claim against Brunswick upon which relief can be granted.

SECOND DEFENSE

Brunswick responds to the numbered paragraphs of Plaintiffs' Complaint as follows:

THE PARTIES

1.

Brunswick is without knowledge of information sufficient to form a belief as to the truth of the allegations contained within Paragraph No. 1 of Plaintiffs' Complaint, which therefore stand denied.

2.

Brunswick admits the allegations contained within Paragraph No. 2 of Plaintiffs' Complaint.

3.

In response to Paragraph No. 3 of Plaintiffs' Complaint, Brunswick admits only that it conducts business in Georgia, including Columbia County, by selling marine products to certain marine product dealers and/or retailers in Georgia, including Columbia County, but Brunswick denies as pled the remaining allegations contained within Paragraph No. 3 of Plaintiffs' Complaint.

4.

Brunswick admits the allegations within Paragraph No. 4 of Plaintiffs' Complaint that jurisdiction is proper in this Court, but denies the remaining allegations contained within Paragraph No. 4 of Plaintiffs' Complaint.

ALLEGED OPERATIVE FACTS

5.

Brunswick is without knowledge or information sufficient to form a belief as to the truth of the allegations contained within Paragraph No. 5 of Plaintiffs' Complaint, which therefore stand denied.

6.

Brunswick is without knowledge or information sufficient to form a belief as to the truth of the allegations contained within Paragraph No. 6 of Plaintiffs' Complaint, which therefore stand denied.

7.

Brunswick is without knowledge or information sufficient to form a belief as to the truth of the allegations contained within Paragraph No. 7 of Plaintiffs' Complaint, which therefore stand denied.

8.

Brunswick is without knowledge or information sufficient to form a belief as to the truth of the allegations contained within Paragraph No. 8 of Plaintiffs' Complaint, which therefore stand denied.

9.

Brunswick is without knowledge or information sufficient to form a belief as to the truth of the allegations

contained within Paragraph No. 9 of Plaintiffs' Complaint, which therefore stand denied.

10.

Brunswick is without knowledge or information sufficient to form a belief as to the truth of the allegations contained within Paragraph No. 10 of Plaintiffs' Complaint, which therefore stand denied.

COUNT I

11.

Brunswick admits that it is a manufacturer of marine products, including outboard motors, but Brunswick is without knowledge or information sufficient to form a belief as to the truth of the remaining allegations contained within Paragraph No. 11 of Plaintiffs' Complaint, which therefore stand denied.

12.

Brunswick is without knowledge or information sufficient to form a belief as to the allegation contained within Paragraph No. 12 of Plaintiffs' Complaint that Brunswick designed, manufactured, and/or sold the outboard motor allegedly involved in the accident described in Plaintiffs' Complaint, which therefore stands denied. Brunswick admits that it has designed, manufactured, assembled, and/or sold outboard motors which can be used with an exposed propeller that could foreseeably cause injury to any person who came in contact with the propeller when rotating. Brunswick denies any remaining

allegations contained within Paragraph No. 12 of Plaintiffs' Complaint.

13.

Brunswick denies the allegations contained within Paragraph No. 13 of Plaintiffs' Complaint.

14.

Brunswick is without knowledge or information sufficient to form a belief as to the truth of the allegations contained within Paragraph No. 14 of Plaintiffs' Complaint, which therefore stand denied.

15.

Brunswick is without knowledge or information sufficient to form a belief as to the truth of the allegations contained within Paragraph No. 15 of Plaintiffs' Complaint, which therefore stand denied.

16.

Brunswick denies the allegation contained within Paragraph No. 16 of Plaintiffs' Complaint.

17.

Brunswick denies the allegations contained within Paragraph No. 17 of Plaintiffs' Complaint, including all subparts thereof.

18.

Brunswick denies the allegations contained within Paragraph No. 18 of Plaintiffs' Complaint.

19.

Brunswick denies the allegations contained within Paragraph No. 19 of Plaintiffs' Complaint.

20.

Brunswick denies the allegations contained within Paragraph No. 20 of Plaintiffs' Complaint.

21.

Brunswick is without knowledge or information sufficient to form a belief as to the truth of the allegations contained within Paragraph No. 21 of Plaintiffs' Complaint, which therefore stand denied. Brunswick denies that it is liable to Plaintiffs for the damages alleged in Paragraph No. 21 of Plaintiffs' Complaint.

22.

Brunswick denies the allegations contained within Paragraph No. 22 of Plaintiffs' Complaint.

COUNT II

23.

Brunswick hereby expressly incorporates by reference its responses to Paragraph Nos. 1 through 22 of Plaintiffs' Complaint as though set forth verbatim herein.

24.

Brunswick denies the allegations contained within Paragraph No. 24 of Plaintiffs' Complaint.

25.

Brunswick denies the allegations contained within Paragraph No. 25 of Plaintiffs' Complaint.

26.

Brunswick denies the allegations contained within Paragraph No. 26 of Plaintiffs' Complaint.

COUNT III

27.

Brunswick hereby expressly incorporates by reference its responses to Paragraph Nos. 1 through 26 of Plaintiffs' Complaint as though set forth verbatim herein.

28.

Brunswick denies the allegations contained within Paragraph No. 28 of Plaintiffs' Complaint, including all subparts thereof.

29.

Brunswick denies the allegations contained within Paragraph No. 29 of Plaintiffs' Complaint.

30.

Brunswick objects that Paragraph No. 30 of Plaintiffs' Complaint contains only a prayer for damages and does not contain allegations which require a response. In any event, Brunswick denies that it is in any way liable for the damages prayed for in Paragraph No. 30 of Plaintiffs' Complaint and denies any and all allegations contained therein.

COUNT IV

31.

Brunswick hereby expressly incorporates by reference its responses to Paragraph Nos. 1 through 30 of Plaintiffs' Complaint as though set forth verbatim herein.

32.

Brunswick denies the allegations contained within Paragraph No. 32 of Plaintiffs' Complaint.

33.

Brunswick objects that Paragraph No. 33 of Plaintiffs' Complaint contains only a prayer for damages and does not contain allegations which require a response. In any event, Brunswick denies that it is in any way liable for the damages prayed for in Paragraph No. 33 of Plaintiffs' Complaint and denies any and all allegations contained therein.

34.

Brunswick denies each and every allegation contained in Plaintiffs' Complaint not specifically admitted to above.

THIRD DEFENSE

Plaintiffs' claims, if any exist at law, are barred as a result of Plaintiffs' decedent's failure to exercise ordinary and due care for her own safety and protection, and said failure to exercise ordinary care was the sole proximate cause of any injuries allegedly sustained by Plaintiffs' decedent and Plaintiffs.

FOURTH DEFENSE

Plaintiffs' claims, if any exist at law, are barred because any injury or damage allegedly sustained by Plaintiffs or their decedent was the direct and proximate result of negligence on Plaintiffs' decedent's part which was equal to or greater than any negligence on the part of

Brunswick. Brunswick specifically denies that it was negligent or is liable in any way for Plaintiffs' alleged damages.

FIFTH DEFENSE

Although Brunswick expressly denies that it or any of its agents were negligent in any way whatsoever, Plaintiffs' decedent's own negligence contributed to the injuries and damages alleged sustained by Plaintiffs. Such damages must, therefore, be reduced in proportion to the amount of Plaintiffs' decedent's negligence.

SIXTH DEFENSE

Plaintiffs' claims, if any exist at law, are bared by reason of the fact that the incident described in Plaintiffs' Complaint and any and all alleged damages resulting therefrom are the sole proximate result of the negligence of third parties over whom Brunswick exercises no control and for whom it is not liable or responsible.

SEVENTH DEFENSE

Plaintiffs' claims, if any exist at law, are barred under the doctrine of assumption of risk.

EIGHTH DEFENSE

Plaintiffs' claims, if any exist at law, are barred because the dangers complained of, if any exist, are open and obvious to ordinary consumers.

NINTH DEFENSE

Plaintiffs' claim, if any exist at law, are barred because the products described in Plaintiffs' Complaint are neither defective nor negligently designed, and are fit for use according to the reasonable expectations of ordinary consumers.

TENTH DEFENSE

Plaintiffs' claims, if any exist at law, are barred by Plaintiffs' failure to support their complaint with an affidavit as required by O.C.G.A. § 9-11-9.1.

ELEVENTH DEFENSE

Plaintiffs' claims, if any exist at law, are barred by the applicable statutes of limitations and repose.

TWELFTH DEFENSE

Plaintiffs' claims, if any exist at law, are barred under the doctrine of Federal Preemption.

THIRTEENTH DEFENSE

Plaintiffs' claims, if any exist at law, are barred because there was and is no safe and feasible propeller guarding device available.

FOURTEENTH DEFENSE

Although Brunswick denies that it is liable to Plaintiffs in any manner whatsoever, Brunswick is entitled to a

reduction in any judgment recovered herein to reflect any amount that Plaintiffs have or may recover from the driver of the boat at issue in this lawsuit or any other persons or entities alleged to have been at fault in the accident at issue herein.

FIFTEENTH DEFENSE

Plaintiffs' claims, if any exist at law, are barred under the doctrines of release, estoppel, and waiver.

SIXTEENTH DEFENSE

Plaintiffs' claim for punitive damages, if it exists at law, is barred because the facts alleged in Plaintiffs' Complaint are insufficient to support the imposition of punitive or exemplary damages under applicable law.

SEVENTEENTH DEFENSE

Plaintiffs' claim for punitive damages, if it exists at law, is barred by reason of the fact that the imposition of punitive or exemplary damages on the facts alleged in Plaintiffs' Complaint would violate the due process and excessive fines clauses of the United States and Georgia Constitutions.

EIGHTEENTH DEFENSE

Plaintiffs' claims, if any exist at law, are barred under the doctrine of payment and accord and satisfaction, Plaintiffs having already recovered full compensation for their alleged damages.

WHEREFORE, having fully responded to each and every allegation contained in Plaintiffs' Complaint, Brunswick prays for the following relief on the basis of its Answer:

(a) That Brunswick have judgment on the Complaint and that Plaintiffs take nothing thereunder;

(b) That all costs of this action be assessed against Plaintiffs; and

(c) That Brunswick have such other and further relief as the Court may deem just and proper.

Respectfully submitted this 3rd day of July, 1995.

By: /s/ Ronald L. Reid (w/perm. by J.W.H.)
RONALD L. REID
Georgia State Bar No. 600100

By: /s/ James W. Hagan
JAMES W. HAGAN
Georgia State Bar No. 316668

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By: /s/ Thomas W. Tucker
THOMAS W. TUCKER
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(706) 722-0771

Attorneys for Defendant
Brunswick Corporation

IN THE SUPERIOR COURT OF COLUMBIA COUNTY
STATE OF GEORGIA

VICKY LEWIS and GARY LEWIS, Individually, as Parents, as Next Friends, and as Administrator of the Estate of Kathryn C. Lewis,	)	
Plaintiffs,	)	CIVIL ACTION
v.	)	FILE NO. CV95-277
BRUNSWICK CORP.,	)	
Defendant.	)	

CERTIFICATE OF SERVICE

I hereby certify that I have served a true and correct copy of the within and foregoing "ANSWER OF BRUNSWICK CORPORATION" upon counsel, by placing same in United States Mail, postage prepaid, and addressed as follows:

David E. Hudson, Esq.
William J. Keogh III
HULL, TOWILL, NORMAN & BARRETT
Post Office Box 1564
Augusta, Georgia 30903

R. Ben Hogan III
HOGAN, SMITH & ALSPAUGH
2323 Second Avenue North
Birmingham, Alabama 35203-3758

This 3rd day of July, 1995.

/s/ Thomas W. Tucker
THOMAS W. TUCKER
Georgia State Bar No. 717975

DYE, TUCKER, EVERITT, WHEALE
& LONG
453 Greene Street
Augusta, GA 30903
(706) 722-0771

IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF GEORGIA
AUGUSTA DIVISION

VICKY LEWIS and GARY LEWIS, individually as parents, as next friends and as administrator of the estate of KATHRYN C. LEWIS, Plaintiffs, v. BRUNSWICK CORP., Defendant.	CIVIL ACTION FILE NO. CV 195-096 (Filed Oct. 13, 1995)

PLAINTIFFS' AND DEFENDANT'S JOINT STIPULATION OF FACTS

COME NOW Plaintiffs and Defendant and stipulate the following facts in connection with the adjudication of all claims in the above-captioned action.

1.

Exhibit "1" hereto is a true, correct, and authentic copy of a letter from R. C. Hill, Chief, State Liaison and Compliance Division of the United States Coast Guard, to Mr. Orrin Lahman, Commissioner, New York State Parks and Recreation Authority, dated December 22, 1975.

2.

Exhibit "2" hereto is a true, correct, and authentic copy of a Memorandum from A. T. Miles, Chief, Operator

Compliance Branch of the United States Coast Guard, to Chief, State Liaison and Compliance Division of the United States Coast Guard, dated August 18, 1976.

3.

Exhibit "3" hereto is a true, correct, and authentic copy of a letter from O. W. Siler, Admiral, United States Coast Guard Commandant, to Mr. William Brey, Chief, Division of Law Enforcement, Illinois Department of Conservation, dated January 12, 1977.

4.

Exhibit "4" hereto is a true, correct, and authentic copy of a Memorandum from G. H. Patrick Bursley, Chief Counsel, United States Coast Guard, to Chief, Office of Boating Safety of the United States Coast Guard, dated July 13, 1977.

5.

Exhibit "5" hereto is a true, correct, and authentic copy of the "Report of the Propeller Guard Subcommittee of the National Boating Safety Advisory Council," including all attachments thereto, dated November 7, 1989.

6.

Exhibit "6" hereto is a true, correct, and authentic copy of the Minutes of the National Boating Safety Advisory Council, Report of the Committee on Propeller Guards, dated November 6-7, 1989.

7.

Exhibit "7" hereto is a true, correct, and authentic copy of a letter from Robert T. Nelson, Rear Admiral, United States Coast Guard, Chief, Office of Navigation and Waterway Services, to Mr. A. Newell Garden, Chairman, National Boating Safety Advisory Council, dated February 1, 1990.

8.

Exhibit "8" hereto is a true, correct, and authentic copy of an article titled "Motorboat Propeller Injuries" prepared by Jon S. Vernick and Associates, The Johns Hopkins University Injury Prevention Center and Institute for Injury Reduction, dated September 1992.

9.

Exhibit "9" hereto is a true, correct, and authentic copy of the deposition of Jim Getz dated February 9, 1990 and taken in connection with a case filed in The United States District Court for the Northern District of Alabama, Middle Division, *Beech v. Outboard Marine Corporation*, Civil Action File No. CV-89-AR-0789-M, excluding two exhibits, true and correct copies of which are attached as Exhibits "6" and "7" hereto.

10.

Although Plaintiff does not stipulate that these documents have any preemptive force or effect with regard to her claims, the parties stipulate that Exhibits "1" through "7" hereto are true, accurate, and authentic copies of

official records of the United States Coast Guard, and that Exhibits "5"-"7" reflect the Coast Guard's official communications with regard to whether marine manufacturers of outboard motors which utilize open-screw propellers should equip such motors with "guards," shrouds, or other similar protective devices, and shall be admitted as evidence in connection with consideration of Brunswick's Motion for Summary Judgment on the basis of preemption and at all stages of the above-captioned lawsuit, including at trial.

11.

The parties stipulate, solely for purposes of adjudicating Brunswick's Motion for Summary Judgment on the basis of federal preemption, that Plaintiffs' decedent, Vicky Lewis, died as a result of injuries she sustained on June 6, 1993, when she fell overboard out of a boat being operated on Strom Thurmond Lake near the Fort Gordon Recreational Area; and that the operator of the boat, Ralph Coffman, was maneuvering the boat into a right-hand turn while pulling his son on an inner-tube behind the boat when Ms. Lewis fell from the port side of the boat.

12.

Plaintiffs contend that Ms. Lewis died as a result of injuries sustained when she fell out of the boat and was allegedly struck by the propeller of the outboard engine installed on the boat. The parties stipulate, solely for purposes of consideration of Brunswick's Motion for Summary Judgment on the basis of federal preemption,

that Ms. Lewis was struck by the propeller. The parties agree that Brunswick reserves its right to contest the issue of whether Ms. Lewis was struck by the propeller at all, the extent of any injuries Ms. Lewis may have received as a result of contact with the boat's propeller, and/or whether Ms. Lewis' fatal injuries resulted from contact with the propeller. That is, the parties agree that this stipulation shall be of no evidentiary effect in any trial of this matter or in connection with any motion other than Brunswick's Motion for Summary Judgment on the basis of federal preemption.

13.

According to a Columbia County Sheriff's Department incident report, the boat involved in the accident was equipped with a 1987 model Mariner 75 horsepower outboard motor. The parties stipulate, solely for purposes of adjudicating Brunswick's Motion for Summary Judgment on the basis of preemption, that Brunswick either manufactured or marketed 1987 model mariner brand 75 horsepower outboard motors; that 1987 model mariner brand outboard motors were designed and manufactured to be equipped with open-screw propellers; and were not equipped with "guards" or other devices that would shroud or otherwise encase propellers installed on 1987 model Mariner brand outboard motors. The parties stipulate, solely for purposes of adjudicating Brunswick's Motion for Summary Judgment on the basis of federal preemption, that Brunswick manufactured the outboard motor involved in the accident at issue in this lawsuit. The parties agree that Brunswick reserves its right to contest the issue of whether or not Brunswick either

manufactured, marketed, or sold the motor involved in the accident at issue in this lawsuit. That is, the parties agree that this stipulation shall be of no evidentiary effect in any trial of this matter or in connection with any motion other than Brunswick's Motion for Summary Judgment on the basis of federal preemption.

STIPULATED TO by and on behalf of Brunswick Corporation this 10th day of October, 1995.

/s/ James W. Hagan
RONALD L. REID
Georgia Bar No. 600100
JAMES W. HAGAN
Georgia Bar No. 316668

Counsel for Brunswick Corporation

ALSTON & BIRD
One Atlantic Center
1201 West Peachtree Street
Atlanta, GA 30309-3424
(404) 881-7000

STIPULATED TO by and on behalf of Plaintiffs this 13th day of October, 1995.

/s/ William J. Keogh III
DAVID E. HUDSON
Georgia Bar No. 374450
WILLIAM J. KEOGH, III
Georgia Bar No. 415781

Counsel for Plaintiffs

HULL, TOWILL, NORMAN & BARRETT
P.O. Box 1564
Augusta, GA 30903

IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF GEORGIA
AUGUSTA DIVISION

VICKY LEWIS and GARY LEWIS, individually as parents, as next friends and as administrator of the estate of KATHRYN C. LEWIS, Plaintiffs, v. BRUNSWICK CORP., Defendant.	)	CIVIL ACTION FILE NO. CV 195-096

CERTIFICATE OF SERVICE

I hereby certify that I have served a true and correct copy of the within and foregoing "Plaintiffs' and Defendant's Joint Stipulation of Facts" upon all counsel of record by placing same in U.S. mail, postage pre-paid and addressed as follows:

David E. Hudson
William J. Keogh, III
Hull, Towill, Norman & Barrett
P.O. Box 1564
Augusta, Georgia 30903
706/722-4481

R. Ben Hogan, III
Hogan, Smith & Alspaugh
2323 Second Avenue North
Birmingham, AL 35203-3758

This 10th day of October, 1995.

/s/ James W. Hagan
JAMES W. HAGAN

ALSTON & BIRD
One Atlantic Center
1201 West Peachtree Street
Atlanta, GA 30309-3424
(404) 881-7000

EXHIBIT 1

22 DEC 1975

Mr. Orin Lahman
Commissioner, New York State Parks
and Recreation
Agency Building
Empire State Plaza
Albany, New York 12238

Dear Mr. Lahman:

In my letter of 24 October 1975 concerning the recodification of New York's Navigation Law, I noted that the matter of Federal preemption of State associated equipment requirements would be discussed at the November 1975 meeting of the National Association of State Boating Law Administrators (NASBLA). As you know, we did discuss the matter, and the proposals noted in the attached informal report were left for NASBLA to consider. I have asked Mr. Fullwood, President of NASBLA, to provide the Coast Guard with NASBLA's positions on preemption. We will withhold a final decision on this matter until such time as Mr. Fullwood responds and we have had an opportunity to work out any differences.

In the meantime, those provisions of your Navigation Law concerning a whistle for boats under 16 feet in length, anchors, distress flag and night flares are in excess to Federal requirements and are subject to preemption. I request that you not enforce those provisions pending the Coast Guard's final action on preemption. Your cooperation in this regard is earnestly solicited for the sake of uniformity of boating laws and regulations among the Federal government and the States.

Thank you for your efforts and cooperation to date in this matter. Please feel free to call upon me if I can be of further assistance.

Sincerely,

R.C. Hill
Illegible U.S. Coast Guard
Chief State Liaison & Compliance Division
Office of Boating Safety
Commission of the Commandant

EXHIBIT 2

UNITED STATES GOVERNMENT
Memorandum

DATE 18 AUG 1976

SUBJECT: Comparison of State vs. Federal Equipment Requirements

FROM: Chief, Operator Compliance Branch

TO: Chief, State Liaison and Compliance Division

1. Enclosures (1) and (2) were prepared as a result of a thorough review by this Branch of State Boating Laws. The Laws are current insofar as we could determine. Where there was a question in this regard, the State was contacted for clarification. Though not all items are classified as "Associated Equipment", the following were addressed as State required excess equipment/operator requirements:

*a. Secondary Propulsion
*b. Bailer
*c. Anchor
d. Line
*e. Distress Signals
f. Battery Shield
g. Murrier
h. Use of Siren
i. Use of Blue Light
j. Yearly Inspection
*k. Personal Flotation Devices
*l. Fire extinguishers

The items preceded by "*" are considered as associated equipment for the purposes of the Federal Preemption issue.

2. Enclosure (3) is a copy of the Project Request Memorandum addressing the Termination of Exemption to Federal Preemption issued on 14 March 1973. Paragraph 1.d., of the PRM lists those States and specific items of equipment which are considered to fall within the definition of associated equipment, and which, under Section 10 of FBSA '71, are subject to Federal Preemption.

3. Particular care has been taken to give the States the benefit of the doubt whenever their laws were hazy, not well defined, or not in strict conformance with the wording of Federal Regulations. For example, if a State required fire extinguishers to be carried "on all boats according to regulations of the Coast Guard", the State was considered to be in compliance. If a State required fire extinguishers to be carried on all motorboats, less the wording "according to regulations of the Coast Guard", that State was considered to require excess equipment.

/s/ A. T. Miles
A. T. MILES

Encl: (1) Listing of State required additional equipment other than PFD's and fire extinguishers

(2) Listing of PFD and fire extinguisher requirements

(3) Copy PRM on Termination of Exemption to Preemption

EXHIBIT 3

(Seal) DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

Illegible JAN 1977

Mr. William Brey, Chief
Division of Law Enforcement
Illinois Department of Conservation
400 South Spring Street
Springfield, Illinois 62706

Dear Mr. Brey:

This is in response to your letter of 30 November 1976 concerning the discussion of fire extinguisher regulations at the National Boating Safety Advisory Council (NBSAC) meeting on 19 October 1976.

The discussion on fire extinguishers was a report to the Council by the Coast Guard that we were not able to find accident data which would justify a change to the current fire extinguisher requirements. Mr. Gruenewald was permitted by the chairman to address the Council and his remarks are a part of the permanent video/audio recording of the meeting. The summary minutes prepared of the meeting to which you refer are for the information of the members and other interested parties and cover only the highlights of the meeting. Since you feel that the comments by Mr. Gruenewald were of significant importance in this matter. I will take steps to incorporate them as an addendum to the minutes of the NBSAC meeting scheduled for February 1977.

A review of the recording indicates that Mr. Gruenewald addressed the subject in three parts: his disagreement

with the Coast Guard's position on the lack of statistical justification; an alleged promise by a senior Coast Guard officer a number of years ago that fire extinguishers would be required on all boats; and that such a requirement would simplify matters for the law enforcement officer. It apparently was primarily this last point which elicited the response to Mr. Gruenewald by the NBSAC member and the Council chairman, who indicated that to require equipment to simplify matters for the law enforcement officer was not a defensible position and one that could not be considered by the Council. The record of the meeting also shows that some States do not support the Coast Guard's position in this matter as reflected in the comments by members Morey, O'Brien and Downing.

Subj: Recent Minutes of the Boating Safety Advisory Council pertaining to Fire Extinguishers on all motorboats.

I am sure that Admiral Lauth and his staff are willing to meet with you to discuss matters related to boating safety at any time. However, you must be aware that under the provisions of Section 6 of the Federal Boat Safety Act of 1971 that the Coast Guard must consider the need for and the extent to which any regulation will contribute to boating safety. For instance, requirements for a dewatering device and a secondary means of propulsion were reviewed and, although recommended for carriage by a prudent boater, could not be justified as a regulation. It is for this reason also that we are seeking additional information before any visual distress signal requirements are placed on the boater.

It was the clear Congressional intent of Section 10 of FBSA '71 that Federal requirements should preempt States' law pertaining to boat and associated equipment standards and carriage requirements. We issued a temporary exemption to this provision, applicable only to those State associated equipment requirements in effect on 10 August 1971 (the effective date of FBSA '71), to enable us to look carefully at each requirement before requiring affected States to change. This was the purpose of our report to NBSAC. Since the Illinois fire extinguisher regulation in question was enacted after 10 August 1971, the preemption provisions of FBSA '71 are in effect.

I trust that we have been responsive to your concern in this matter. Please feel free to call upon the Coast Guard if we can be of further assistance.

Sincerely,

/s/ O. W. Siler
O. W. SILER
Admiral, U. S. Coast Guard
Commandant

Copy to:
Mr. Edward J. Heine, Jr., Chairman
National Boating Safety Advisory Council

EXHIBIT 4

UNITED STATES GOVERNMENT
Memorandum

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

G-EMI/81
16751
DATE 13 JUL 1977

SUBJECT: Federal Preemption of California Assembly

FROM: Chief Counsel

TO: Chief, Office of Boating Safety

REF: (a) G-BA-1 memo 16751 dtd 13 Jun 1977

1. Reference (a) requested an opinion as to whether that portion of California Assembly Bill #876 which relates to boating safety is preempted by Section 10 of the Federal Boat Safety Act.

2. Although the Coast Guard has not promulgated regulations governing the use of liquified petroleum gas on recreational boats carrying six or fewer passengers, it is my opinion that this subject matter was intended by Congress to be included in the definition of "associated equipment" as set forth in §3(8)(B) of the FBSA. The legislative history of the Act is replete with references of the need to reduce the number of boating accidents caused by fire and explosion, not only from main fuel systems, but also from other sources. During hearings preceding enactment of the FBSA, Admiral Wagner testified that the Coast Guard would concentrate its efforts under Section 5 of the Act to reducing the

number of deaths, injuries and property damage due to fire and explosion by devising appropriate safety standards.

3. In light of this intention to include liquified petroleum gas equipment within the definition of "associated equipment," as evidenced by the legislative history of the FBSA, it is my opinion that the proposed California Assembly Bill, as it pertains to the regulation of boating safety standards, would be invalid in the absence of express federal approval. The appropriate state officials should therefore be notified that an exemption granted under Section 9 of the FBSA would be required to validate the proposed state regulation.

4. Although the proposed legislation is worded to prevent the sale, rather than the manufacture, of boats without the leak detection device, it is my opinion that Section 10 of the FBSA would nonetheless apply in this case. Section 10 prohibits the states from establishing any requirement for associated equipment. By mandating the proposed leak detection device, California, in effect, would be establishing such a requirement indirectly.

/s/ G. H. Patrick Bursley
G. H. PATRICK BURSLEY

EXHIBIT 5

The National Boating Safety Advisory Council

REPORT
OF THE
PROPELLER GUARD
SUBCOMMITTEE

Presented
November 7, 1989

CAPT. James E. Getz, Chairman, State Member
Mr. Donald J. Kerlin, U.S.C.G. Representative
Mr. Richard H. Lincoln, Industry Member
Mr. William D. Selden, Public Member
Mr. Herman T. VanMell, Public Member

REPORT OF THE PROPELLER
GUARD SUBCOMMITTEE
OF THE
NATIONAL BOATING SAFETY ADVISORY COUNCIL

I. INTRODUCTION: THE SUBCOMMITTEE AND ITS PURPOSE

At the request of the U.S. Coast Guard, the National Boating Safety Advisory Council (NBSAC) on May 11, 1988, appointed a subcommittee to consider, review and assess available data concerning the nature and incidence of recreational boating accidents in which persons in the water are struck by propellers. Feasibility of some form of mechanical guard or other action to prevent such contact was to be examined. A copy of the charge to the Propeller Guard Subcommittee (the Subcommittee) is attached as Appendix A.

The Subcommittee determined that no minutes or transcripts would be kept but that, at the conclusion of its work, all documentary materials received be delivered to the Coast Guard for its files, and that the Subcommittee's final report to NBSAC, together with minority or dissenting statements, if any, stand as the definitive record of its work.

II. INFORMATION OBTAINED

At the outset, the Coast Guard supplied materials from its files to the Chairman, who sent requests to the persons and organizations listed in Appendix B asking for files, data, case histories and other information bearing on the subject. Documents received were copied and distributed to each member of the Subcommittee for study prior to the first meeting. At the conclusion of that meeting, the Subcommittee developed a comprehensive list of further documentation, materials and information to be sought, and of persons to be invited to meet with the Subcommittee. Documents and materials were also volunteered by interested parties. Video tapes and other visual materials were exhibited at the meetings. Appendix C lists all documents received and considered, along with video tapes and visual materials reviewed by the Subcommittee.

III. MEETINGS HELD

The first meeting of the Subcommittee was held at the Boston Whaler facilities at Rockland, Massachusetts, on September 22 and 23, 1988. Various types of propeller guards, both commercially available and experimental,

underwater motor housing appendages and other relevant materials were presented but not deposited with or retained by the Subcommittee. Members of the Subcommittee also viewed and were given a hands-on opportunity to operate Boston Whaler boats used by the U.S. Marine Corps, one equipped with a "Chadwell" ring-type guard, and the other without.

The second meeting was held in New Bern, North Carolina, on November 14, 1988, and a third meeting at Couer d'Alene, Idaho, on May 12 and 13, 1989. Following that session, the Subcommittee concluded that sufficient written and verbal presentations and demonstrations had been seen and heard to cover the field; collection of documentary material amassed and reviewed was reasonably representative of presently available, relevant data; and further document search or additional meetings with concerned persons was unlikely to produce substantial additional information.

Between the May 1989 and November 1989 NBSAC meetings, this report was drafted and unanimously approved by Subcommittee members, and the Chairman was directed to deliver it to NBSAC at its regular meeting scheduled for November 6, 1989. The Chairman was directed that, following NBSAC action on the report, all documents and other materials collected by the Subcommittee be delivered to the U.S. Coast Guard for its files.

IV. INDIVIDUALS HEARD

The following persons made presentations to the Subcommittee and generally made themselves available for questioning and discussion. Other interested persons

attending the meetings are listed in the order of appearance:

1. Richard Snyder: Principle Engineer-Product Evaluation with Mercury Marine. Has testified in behalf of Mercury as Defendant in opposition to guards.
2. Brian Chadwell: designer, manufacturer and seller of ring-type propeller guards. Has testified on behalf of plaintiffs in propeller strike litigation.
3. Ben Hogan: attorney for plaintiffs in such cases and proponent of guards.
4. Donald Blount: civilian naval architect, 34 years with the U.S. Navy, heading the section for design and testing of small boats. Has testified for defendants.
5. Lars Granholm: at one time employed by the Coast Guard as an engineer, currently Director of Industry Safety Standards for the National Marine Manufacturers Association. Has testified for defendants.
6. D. P. Huelke: Professor of Anatomy, University of Michigan, researcher and consultant on trauma injuries, particularly in the automobile industry. Has testified for defendants.
7. Robert Taylor: marine engineer and naval architect, formerly of the University of Michigan and U.C. Berkley, former ship designer for the U.S. Navy, and currently Supervising Marine Engineer of Failure Analysis, Inc. Has furnished statistical data on behalf of defendants.
8. Dr. James Benedict, M.D., Biodynamic Research Corporation, a researcher on effect of traumatic

impact on the human body. Has testified on behalf of defendants.

9. Ms. Linda Earnby: victim of a propeller strike injury and advocate of guards. Represented the Florida Audubon Society.

10. Dr. Albert Burstein: New York City's Hospital for Special Surgery, a mechanical and biomechanical engineer specializing in sports related injuries and development of protective devices.

Dr. Lawrence E. Thibault, of Biomechanics, Inc., and the University of Pennsylvania, who has testified as a plaintiff's expert biomechanics witness in numerous propeller strike cases, accepted an invitation to participate in, and was scheduled for the Idaho meeting, but failed to appear. (The Subcommittee had previously received a copy of his report and letter dated August 14, 1987, prepared for plaintiff's attorney Stephen R. Bolden in seven of the 19 propeller strike cases described in the report).

In the Subcommittee's deliberations, reports prepared by engineers John G. Hill, Arthur M. Reed and Robert Taggard, in support of plaintiffs in litigation, were reviewed, along with other pertinent documents. (See Appendix C)

V. KEY POINTS COVERED BY VERBAL INPUT AND WRITTEN MATERIALS

1. Litigation

A number of law suits have been filed by victims of alleged propeller strikes to recover damages from the

operator of the striking vessel and also against the manufacturer of the propulsion unit and/or boat. In those cases seeking to hold the engine manufacturer liable, the following legal theories have been asserted by propeller guard advocates:

a. The manufacturer has a duty to design boat propulsion machinery in a prudent manner which includes a duty to design against hazards, if feasible. Since propeller injuries are a known hazard, and guards are presumed feasible, a manufacturer is negligent and liable for damages (regardless of, or in addition to, liability of the boat operator), for failing to incorporate guards.

b. Alternatively, if no feasible guards presently exist, the manufacturer is nevertheless presumed liable for failure to have funded and conducted whatever research and development may be needed to design and produce effective guards.

c. Guards, in addition to protecting persons, also protect propellers from destructive bottom contact. They are currently feasible and available, and manufacturers should be liable because they choose not to furnish guards in order to profit from sale of replacement propellers.

Advocates have petitioned federal and state legislators and regulators to mandate propeller guards. Such mandate would necessarily be predicated on the feasibility of guards and establish prima facie manufacturer liability in having failed to provide them. Feasibility, accordingly, is one of the important questions before the Subcommittee.

In defending "propeller strike" cases, engine and boat manufacturers have asserted:

a. Guards are feasible only at idling or very low speeds and for limited purposes, but are not feasible at normal operating speeds at which the majority of propeller strike accidents occur.

b. A very high percentage of the reported accidents of "struck by boat or propeller" do not involve propeller strikes, but involve impacts with the boat hull or a stationary component of the lower unit.

c. At normal recreational boat operating speeds the increased drag and hydrodynamic characteristics created by known types of guards cause a new hazard by dangerously affecting the handling and stability of the vessel.

d. Since all types of known guards substantially increase the frontal area of the underwater appendages of an engine, the chances that a victim will be hit are greatly increased.

e. A victim hit by other than a very slight glancing blow from the guard on a boat operating at normal or planing speeds, will suffer impact injuries more devastating than being cut by a propeller.

f. The ring-type and wire mesh or "catcher's mask" guards create a new hazard of catching and trapping a victim's limbs resulting in more severe injuries and/or drowning.

g. To recover normal operating speeds lost to guard drag, the engine horsepower and fuel consumption must be raised by at least 50% with consequent and proportionate increases in exhaust emissions.

h. To retrofit the propulsion units now in existence would require the design and manufacture of several thousand different guard models, since each one must be individually designed for the engine to which it is to be fitted. Every unit must be engineeringly modified for the boat hull on which the engine is mounted, to guard against dangerous handling characteristics.

Manufacturers are opposed to mandatory propeller guards and assert that propeller strike accidents constitute less than 5% of the total annual boating fatalities. They assert that safety efforts and education should address operator incompetence, negligence and alcohol involvement. Improvement in the overall field of safe boat handling would, in the same proportion, beneficially affect the incidence of propeller strikes and underwater impacts.

2. Statistical dimensions of the problem

Statistical sources include accident reports filed with the Coast Guard, hospital emergency room sampling by the National Electronic Injury Surveillance System (NEISS), state records, insurance records, and statistical sampling and analysis of selected groups of cases by professional organizations. There are obvious variations in reported statistics. No universally accepted, accurate and complete compilation came to the Subcommittee's attention.

Reports of individual accidents are made at varying times after the accident and may be prepared by the operator, the victim, or an enforcement officer who normally has not seen the accident and must rely on witnesses, if available. Attending physicians in emergency rooms, under the pressure of giving immediate medical

or surgical attention, will have difficulty in understanding exactly what happened and in what sequence. Of these people, very few, if any, will have undergone specific training to qualify them as experts in determining the cause of such injuries.

The standard form of boating accident report as prepared by the Coast Guard and followed by many state agencies has one category to be checked under the box "type of accident" identified as "hit by boat or propeller". Such reports, principal source of statisticians, do not distinguish whether the victim's injury resulted from striking by the boat, the underwater propulsion unit which precedes the propeller (namely, the gear housing, skeg, anti-ventilation plate), or by the propeller, or a combination of all three. (See Figures A and B) The reporting form also does not have a specific space for reporting speed at the time of the accident.

The Coast Guard believes that only 5 to 10% of all boating accidents, not involving fatalities, are reported. The Subcommittee believes that the completeness of accident reporting varies proportionately to the severity of the injury, from nil in the case of very minor injuries, to fairly complete in fatalities.

Although available statistics are imperfect and incomplete, it is probable that the circumstances influencing the preparation and filing of reports remain constant. Thus year-to-year comparisons and trends, particularly as to fatalities, are reasonably informative and valid for the purposes of this inquiry.

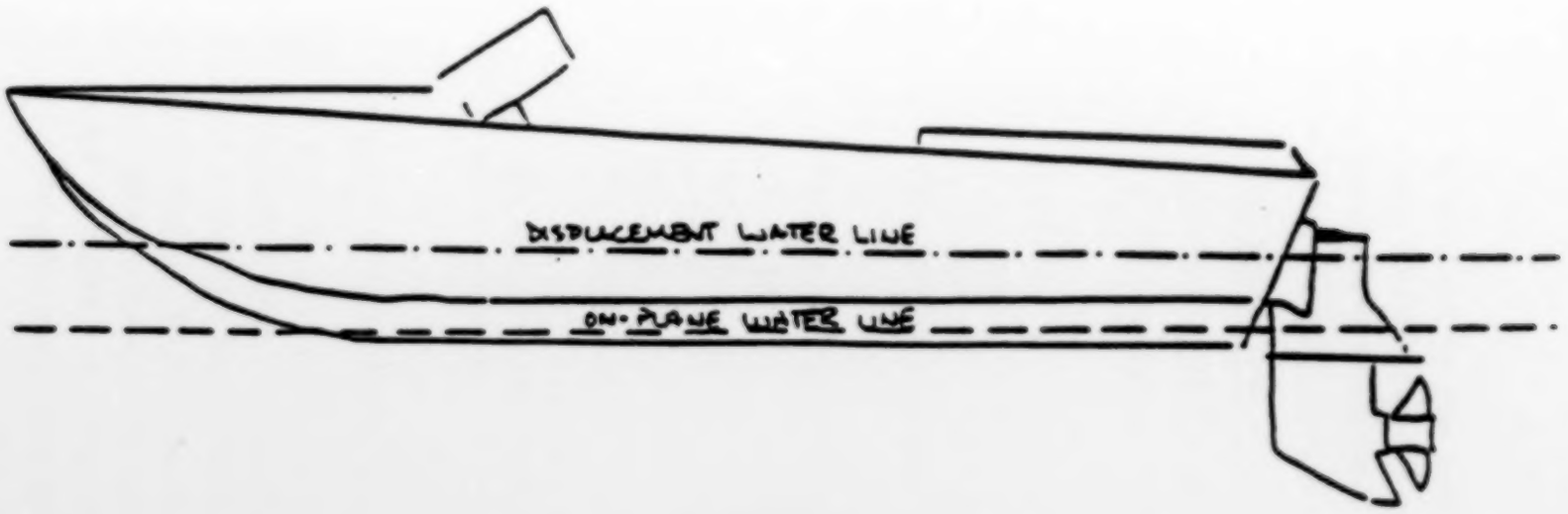

Figure A

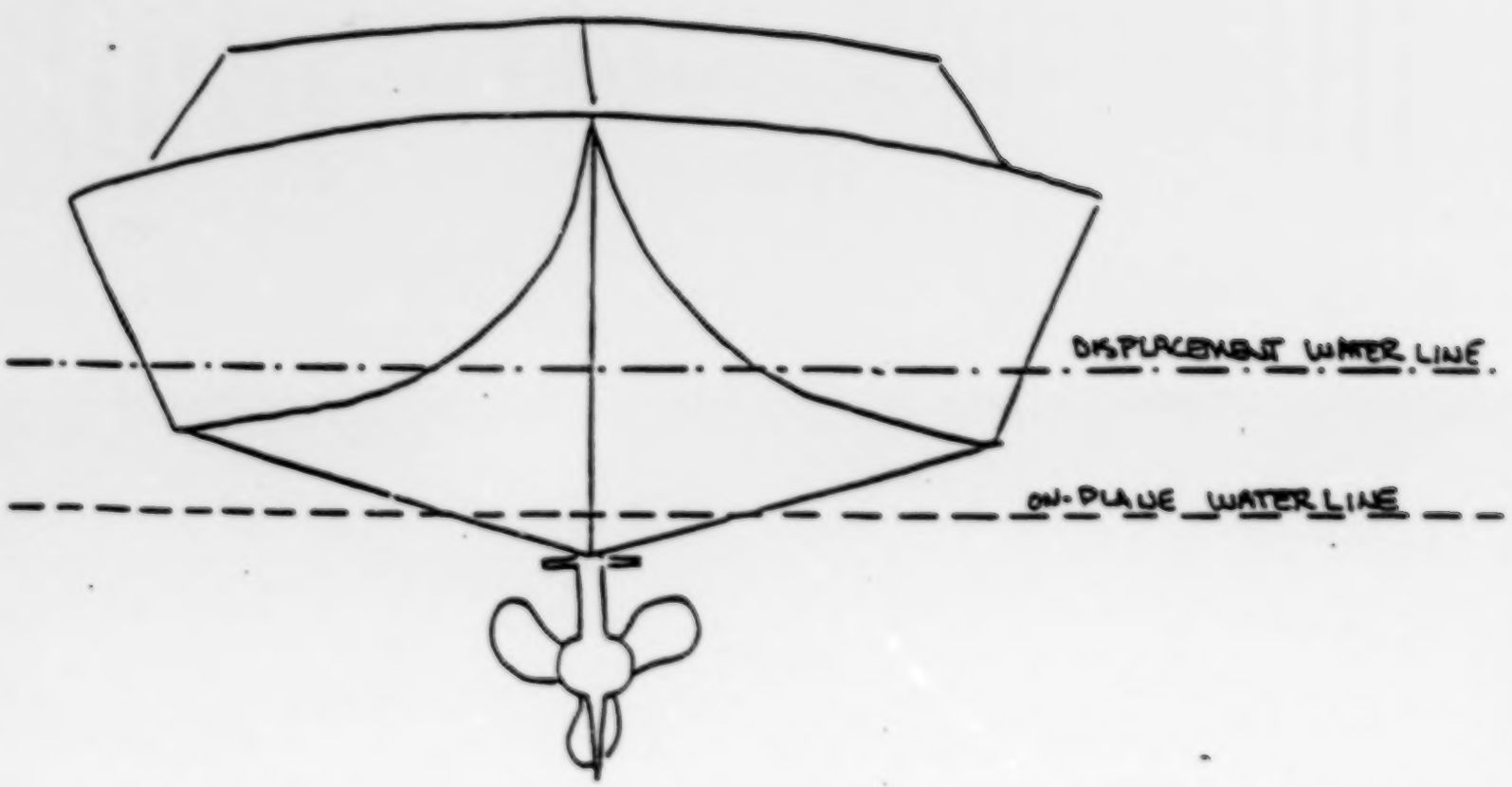

Figure B

In contrast to the obvious deficiencies of accident reporting, statistics on the number and types of boats and engines manufactured and in use can be considered accurate. The following data was used by the Subcommittee:

Boat population of the United States as of 1988

Horsepower of the engine(s)	number
*None (rowboats, canoes, inflatables)	4,100,000
1 to 5	1,600,000
6 to 10	2,100,000
11 to 30	1,700,000
31 to 50	2,300,000
51 to 100	2,500,000
Over 100 horsepower	2,700,000
	17,300,000

Boat length by feet

Under 16	9,515,000
16 to 25	7,149,000
26 to 39	568,000
40 to 65	95,000
Over 65 feet	11,000
	17,300,000

*Exception: only occasional use of low horsepower engines.

3. Annual recreational boating fatalities

Robert Taylor of Failure Analysis, Inc. presented information from his organization's data base which had been compiled from all major statistical sources (See Appendix E). Summarizing such statistics for the year 1982: fatality total for recreational boating was 1,183 compared to 1,594 for swimming pools, 1,900 for firearms (excluding homicide and suicide), 2,800 swimming, 4,453

motorcycles, with motor vehicle fatalities exceeding 43,000. For open motorboats of 14 to 18 feet in length, the contributing factors to fatalities were: falls overboard 35.8%, capsizing 31.9%, collisions 21.2%, swamping/flooding 8.9%, and struck by propeller 4.9%.

The calculated risk of fatality in 1982 per each million activity hours of recreational boating was said to be 1.26 for inflatables, 0.62 for canoes/kayaks, and 0.59 for rowboats, in each case with no engine being involved, compared to a risk of 0.14 from all causes for open motorboats (within which the risk of propeller strike itself is very small fraction). The estimated number of fatalities per million exposure hours in recreational boating (0.14) was compared at the bottom of a list of other recreational activities, with 0.88 in hunting, 1.41 in high school and college football games, 3.08 in scuba diving and 17.34 in private flying.

Water skiing was considered a special risk in itself (separate from the category of recreational boating) and, according to Failure Analysis data, accounted for some 40 annual fatalities (only a portion of which were propeller strikes). It is estimated that over 14,000,000 persons participate in water skiing annually.

4. How propeller strike accidents occur

In almost all cases the victim is in the water, as a swimmer, snorkeler or scuba diver, a downed water skier, or more frequently, as a result of falling or being thrown from a boat. While some victims have been struck by

propellers in the air in accidents where one vessel collides with and passes over another vessel, such incidents appear to be rare.

Passengers moving about or improperly seated, such as "bow riders", or persons sitting on the gunwales or transom, are ejected by sharp turns, wave or wake bounces, all at speeds which may be too fast for the prevailing conditions. Persons also are ejected from boats by collision with another vessel or fixed object. Operator inexperience, incompetence, negligence, and alcoholic intake are significant contributing factors in reported "propeller strikes" as well as in other kinds of boating accidents. Ejections can also be caused by sudden acceleration or deceleration, either from operator error, equipment failure or malfunction, or striking masses of weeds or other submerged objects.

Presentations illustrated that approximately 80% of all accidents occur when a boat is operating at speeds in excess of 10 miles per hour, i.e. normal operating or planing speeds. Accidents occurring at idling or slow speeds (2 to 10 miles per hour) most typically appear to happen when the operator is in the process of picking up a fallen water skier, moving in the vicinity of swimmers, or inadvertently putting an engine in gear when swimmers are using a boarding ladder or platform.

5. Types of propulsion

The most common propulsion unit used is the outboard motor, mounted on the stern of a boat and rotated to steer the boat. Second is the inboard/outboard device, powered by an engine mounted inside the boat, with an

exterior drive unit containing a gear case and propeller, which is moved from side to side to steer the boat. In both cases, the lower unit, including the propeller, serves as the rudder in steering the boat.

A third common means of propulsion is an engine mounted in the boat to power a shaft passing through the hull, and generally through a supporting strut, at the end of which the propeller is mounted. Such boats are steered by one or more separate rudders and may be either planing or displacement boats. Included in displacement boats are sailing vessels with inboard mounted engines and a shaft through the hull, sometimes off-center and sometimes on center line, with a cut out or other space between the shaft and a rudder, auxiliary sail boats commonly travel at speeds, when under engine power, well below 10 mph. Many small sailboats use low power outboard motors for auxiliary propulsion at low speeds. Auxiliary powered sailboats did not figure in any propeller strike accidents coming to the Subcommittee's attention.

In a fourth propulsion method, water is taken in through a submerged scoop and ejected by an impeller as a high speed jet of water pushing astern. A steering rudder may be required. Outboard jet engines have appeared on the market in recent years, particularly for fishing in very shallow water. Manufacturers state that jet drive outboards are 25% less efficient than comparable horsepower propeller driven outboards. In traditional boat types, jet propulsion units do not appear to have succeeded commercially. This has not been the case, however, with "personal watercraft". This jet-driven type of

boat is increasingly figuring in accident and fatality statistics through collisions with other vessels or with swimmers in the water and operators falling in the vicinity of other craft.

6. Propeller guard designs and availability

Although many variations have been conceived and patents granted, there are essentially only three basic configurations of "propeller guards".

First is a ring band device commonly secured to the submerged portion of an outboard motor or stern drive unit and within which the propeller revolves. Unless supplemented by sufficient bars or mesh across the rim front and back, fingers, hands, arms, etc., can enter the ring and contact the propeller. Proponents of guards assert that most victims are struck at an angle to the boat, rather than frontally; that a boat in motion creates a pressure wave tending to push bodies to the side; and, therefore, that in most impacts a victim would receive only a minor glancing blow from a guard. As to frontal hits with a guard in place, it is asserted that the leading edge of the ring could be constructed of crushable material to absorb the energy of the impact, or be cushioned with flexible material covering metal or plastic parts, thus preventing serious injury to the struck victim.

Opponents assert that a blow from a guard, either frontally or at an angle from a boat traveling at speeds of over 6-10 miles per hour or any boat at planing speed, could cause serious or fatal impact if hitting the head or chest; that at such speeds a human body in the water is held stationary relevant to the striking force, and there is

no wave effect pushing bodies to the side. Also, there is no known material available which, as a part of a propeller guard, could absorb energy on impact with the human body in water and maintain its shape and structural integrity under normal use. Opponents further assert that this guard significantly increases the total area of possible underwater impact.

The second general type of guard is a screen surrounding the propeller like a fan cage or catcher's mask, constructed of wire mesh, bars or wires. Some patents show bars forward of the propeller, some vertical, some horizontal or combinations. To maximize protection, mesh must be small enough to prevent insertion of limbs and/or appendages and totally encompass the propeller. The mask device also significantly increases the total area of possible underwater impact. In the use of both the ring and the mask-type guards, opponents have stressed that the frontal impact area would be increased by three times by attaching the guard (See Figure C). They further contend that, while a submerged body limb may not be struck by the rotating blades of the propeller, they would certainly be struck by the guard, if the limb were in the path of the lower unit.

A third type is shrouding the propeller in a tunnel or tube, and in its most common application is referred to as the Kort nozzle. This was designed to control water flow to and through a propeller to increase its efficiency by producing greater power at low speeds, such as for tug boats and large ships. Vanes can be inserted in both the forward and aft ends of such nozzles to direct the flow of water for maximum efficiency and serve as barriers to the entry of body parts.

Examples of the ring and mask types of guards were examined by the Subcommittee. No example of any nozzle device suitable for recreational boat use at normal operating speeds was brought to the attention of the Subcommittee. No guard device suitable for inboard engine drive propellers on displacement or planing motor boats, or on auxiliary sail boats was presented.

7. Present use of guards

Fine mesh cage guards have been used for many years on amusement park bumper boats, which operate at very slow speeds (approximately 2 miles an hour or less) where problems of drag, engine efficiency, structural integrity and boat handling are negligible. Also, a blow to a person in the water at such very slow speeds has minimal effects. No evidence indicated that this solution had any validity for normal use of pleasure boats at normal planing speeds.

The mask guard with spaced rods is used in various parts of the world on rescue boats, often on inflatables, powered with 25 or more horsepower engines. In the typical rescue operation, the boats speed to the rescue scene and then operate at slow or idle speed while carrying out the rescue. The wide spacing of the bars required to minimize critical drag in speeding to the rescue scene does not prevent entry of body appendages.

It was reported that approximately 2,000 of the "Chadwell" ring-type guards have been sold, with some used on rescue boats in Australia and New Zealand and California. Some boats used by the U.S. Marines have been equipped with these guards. The intended use is to

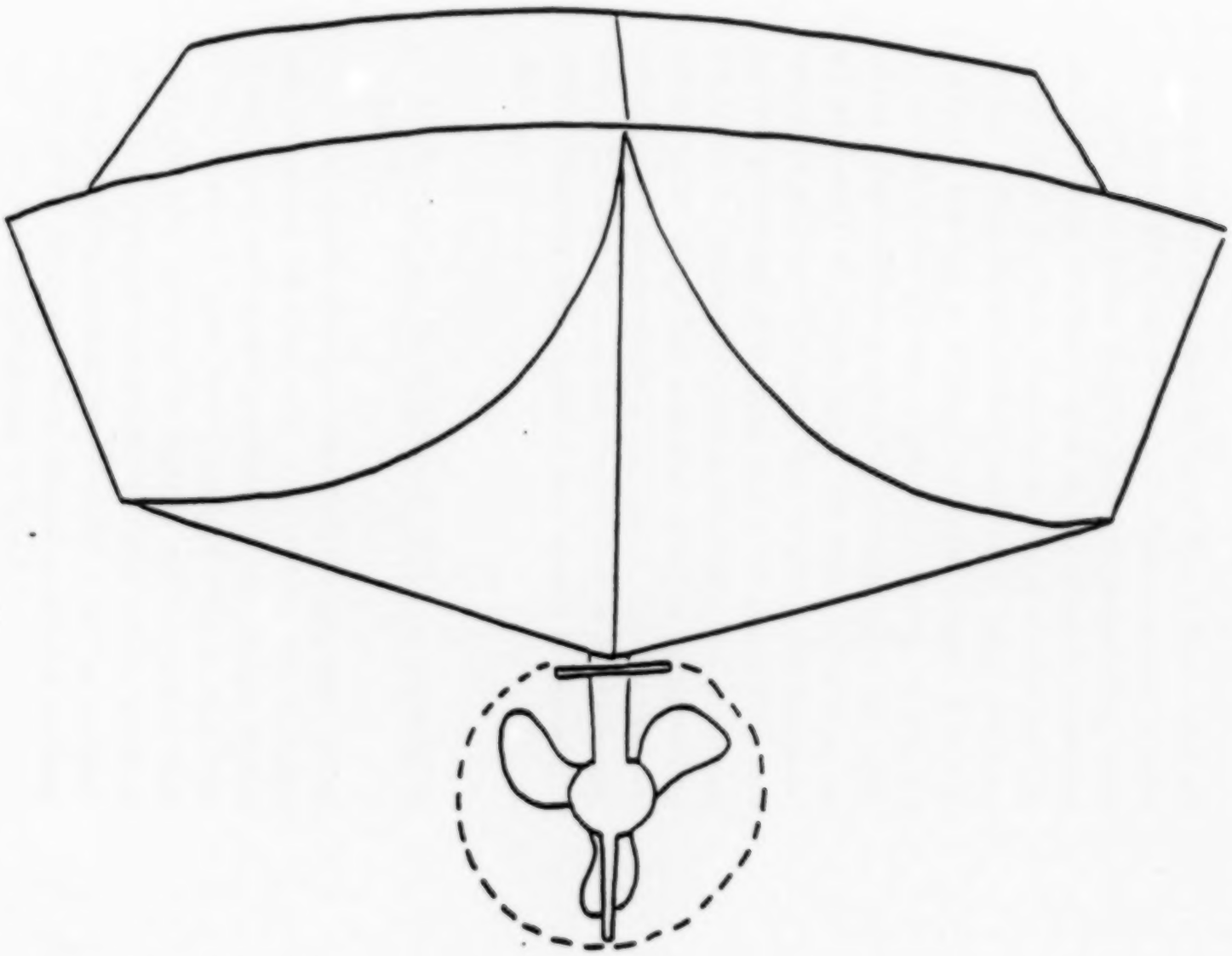

Figure C

deposit Marine personnel in the surf and then stand offshore to await their recovery. In this simulated combat situation, it is critical to keep the motors operating, while also affording a certain degree of protection to personnel in the water. The Subcommittee understands that the U.S. Marine Corps is undertaking additional, more extensive study on the use of different types of guards. The U.S. Navy makes limited use of guards (although it was not stated whether they were rings or masks) to minimize entanglement of diving hoses on some boats used as diving platforms. The Navy has used "nozzle shrouds" around propellers of landing boats operating from well decks on the mother ship to move cargo and personnel ashore. This usage has a prime objective of protecting propellers from mechanical damage in striking the bottom of the well deck or submerged objects on the beach, while achieving high thrust at low speeds for more efficient operations.

8. Mechanical and hydrodynamic problems inherent in guards

It was clearly demonstrated that the ring-type guard creates severe steering and trim effects which cause serious safety and control problems. In the demonstration of the Boston Whaler boat equipped with a ring-type guard, the boat could not be brought out of a turn at high speed unless power was quickly reduced. In the hands of an inexperienced or negligent operator, a serious accident could result. Rings and their mounting devices increase drag with corresponding loss of speed.

An engineer for one of the engine manufacturers described experimental work done for the Marine Corps on a mask guard which would have less severe steering and trim hazards than a ring guard and was expected to be less subject to critical damage on hitting bottom or submerged objects. The first cage, built of 5/16" diameter steel rod stood up structurally, but its drag reduced boat speed from 35 mph to 19 mph (when compared to use without a propeller guard). The second, built of 1/4" diameter steel rod more widely spaced solved steering but not drag problems, and vibration forces broke the welds. The added drag due to this mask or cage reduced boat speed from 37 mph to 27 mph (with two 70 horsepower engines). It was stated that, to regain the desired speed of 37 miles an hour, horsepower would have to be increased 100% to a total of 280. It was also found that the mask, as well as the ring-type guards, was vulnerable to crushing on hitting the bottom, pushed down by the weight of the boat bouncing in the waves, with consequent disablement of the engine. It was further stated that the objective of simultaneously protecting the propeller from damage, protecting landing personnel, and making no material sacrifice of speed involved irreconcilable physical laws and an insoluble manufacturing dilemma. To make the guard strong enough to withstand hitting the bottom or hard object resulted in unacceptable drag and handling – and to conserve desired speed, steering control and prevent entry of body appendages the guard would have to be so lightly constructed that it could not stand up to normal operating loads.

9. Biomechanical considerations

The density of water is approximately 830 times that of air. The density of the human body is approximately the same as water. Therefore, it follows that a human body immersed in water cannot move independently of the water around it. The result of an object striking a human body in the water is that the body absorbs most of the energy of the striking object. As the speed of a striking object increases, the transferable energy increases by the square of that speed, and the force of the blow becomes correspondingly greater. The resistance force on body movement in water at 1 mile per hour is the same as a force of 29 mph in the air. It was repeatedly stated that a skull impact at 10 mph or more in the water would be generally fatal. A glancing head blow twisting the neck could result in a sheared neck at such speeds, and a chest strike could result in rib flexing in an unsustainable amount. Even with an idealized cushioning material, not currently known to exist, head or body cavity strikes at speeds over 10 mph could likely be fatal.

The auto industry and independent researchers have an extensive data bank resulting from numerous crash tests using technically sophisticated, instrumented manikins, from which generally accepted tables have been constructed concerning the forces which result in serious and fatal injuries. Although there are no such completed studies available regarding underwater impacts, tests have been conducted which reveal significant similarities. Video files of boats striking simulated limbs, surgically comparable to human limbs, and other submerged objects illustrated the injury-causing forces involved when an 18 to 25 foot boat, weighing up to thousands of pounds,

traveling at speeds varying from 10 to 35 mph hits a body or object.

The human body has numerous rotational joints, i.e. the neck, wrists, fingers, elbows, ankles, etc. All are subject to serious and permanent injury depending on the force and mass involved in the impact. An oblique strike by any underwater appendage can result in rotational injury or injury transmitted to another part of the body. According to Failure Analysis data, sports trauma, such as high school and college football, has nine times the fatality risk of recreational boating. This data reinforces the promise that serious or fatal injury can result from even relatively low speed and/or mass impact depending on the angle of the striking force and the location of the impact.

Propellers present the hazard of cutting wounds and penetrations of the body, while other underwater appendages, including guards (which increase significantly the potential impact area) present the additional hazard of blunt trauma injuries, which are often more severe.

It was stated that at a speed of 10 miles an hour, any fixed appendage of a boat (example: the skeg of an outboard motor) crosses a submerged limb in 1/50th of a second. With the water holding the limb relatively immobile, the limb tissue is torn, then the bone is crushed, producing a wound more serious than propeller cuts. Due to its revolutions, a propeller generally produces a series of evenly spaced cuts which are relatively easier to repair surgically.

All machinery or objects, whether created by man or nature, can inflict injury. It is impossible to make everything totally free of hazard. At a cost, we can be protected against many hazards. Most of the annual 43,000 motor vehicle fatalities, for example, could probably be prevented by mandating a national speed limit of 10 mph. The economic and social cost, however, would be unacceptable.

By definition, a guard must both diminish a hazard and leave the object capable of normal function, at a cost which is reasonable in proportion to the extent of the hazard. Diminishment of hazard is classically accomplished by various means, including barriers, shut down devices, warnings and education for safe use. Above all, it is fundamental that a guard should not create a condition which leads to a new or worse hazard.

VI. SUMMARY

Up to 80% of underwater impact accidents occur at normal operating speeds, in excess of 10 mph and more usually in the 13 to 35 mph range. The craft most typically involved is in the 15 to 25 foot range, powered by an outboard or inboard/outboard unit or units of 25 horsepower or more. This also is the bracket where the great majority of all accidents involving powered vessels occurs. Recent data reveal an increasing level of involvement of personal watercraft in boating accidents. The risk of accident increases during water skiing activity.

Nevertheless, boats and motors should be designed to incorporate technologically feasible safety features to avoid or minimize the consequences of inexperienced or

negligent operation, without at the same time (a) creating some other hazard, (b) materially interfering with normal operations, or (c) being at economic costs disproportionate to the particular risk.

Proponents assert that propeller guard technology and/or availability meets the foregoing criteria and that guards should be mandated. The Subcommittee does not agree and offers the following comments:

1. The concept of mask and ring-type guards is feasible at idling and very low speeds. Fine mesh guards can prevent propeller contact but are not feasible above 2-3 mph, which rules them out for recreational boating. Masks with wide mesh or spaced bars and ring guards may prevent cuts from body contact with a propeller but substitute the potential of blunt trauma injury, which becomes increasingly significant at speeds over 10 mph, leading to an ascending serious risk of fatality as speeds increase. In recent accident reconstruction training exercises, it has been demonstrated that boats and their appendages can easily be construed as projectiles. Boats operating at planing speeds can easily penetrate or cause serious damage to other boats. These demonstrations serve to reinforce the damage potential of boat impacts with persons in the water. Either guard presents an underwater profile of significantly larger frontal area, thereby increasing the chances of contact. In the case of the ring-type guard, a new hazard is created, in that an arm, leg, etc., may be caught by the bars or ring and held against the rotating propeller. Operators of a

"guard-equipped" boat can be expected to have a false sense of security when approaching persons in the water at slow speeds, with a very real risk of impacting and/or entrapping a body appendage.

2. A speeds of approximately 10 mph or greater, both types of guards – especially the ring – affect boat operation adversely. Both guard types result in drag increasing proportionally to the square of speed, resulting, in substantial power and speed loss. This will require greatly increased power and fuel consumption to regain the lost speed.

3. Propellers encased in the Kort nozzle, or tunnel, substitute impact for propeller cut hazard, have rapid loss of efficiency above 10 mph and are not operationally feasible at normal pleasure boat speeds. The Kort nozzel is viewed as a low speed efficiency enhancer and not a guard.

4. Water jet propulsion eliminates the propeller and diminishes the underwater appendage impact area, but at a minimum 25% loss in efficiency and results in newly created operational handling problems.

5. No known materials are available to construct "soft" propellers or to construct or coat guards so as to absorb impact energy and prevent injury, yet maintain structural integrity and serve the intended purpose.

6. Adequate seat belts, if used by all boat passengers, could prevent some operator and passenger ejections into the water. A belted person involved in a capsizing, however,

would then be subject to the risk of death by drowning.

7. Any guard would have to be both hydrodynamically and structurally compatible with the intended propulsion unit. Further, guards must not only fit the motor but be designed for hydrodynamic compatibility with the hull on which the motor is used. Since there are hundreds of propulsion unit models now in existence, and thousands of hull designs, the possible hull/propulsion unit combinations are extremely high. No simple universal design suitable for all boats and motors in existence has been described or demonstrated to be technologically or economically feasible. To retrofit the some 10 to 15,000,000 existing boats would thus require a vast number of guard models at prohibitive cost.

8. The suggestion that guards should be mandated, at least for water ski boats during which activity accidents occur at both high and very low speeds, and for boats equipped with swimming platforms and ladders, presents other problems. Water skiing or swimming from a boat is a part-time and limited activity and does not describe a boat type. Recreational boats are multi-purpose in nature, which precludes the practicality of an off-on use of a propeller guard. If guards were readily removable, automotive experience clearly shows that they would be by-passed by permanent removal. The Subcommittee feels that it is not practical or feasible to mandate guards for specific uses, such as water skiing or while a boat is

being used as a swim platform. Furthermore, the removal of a guard could result in inadvertent or intentional overpowering of the boat.

CONCLUSIONS

1. Accident data and the analysis of accident data must be an integral component of a study of this nature. There is no one single source, best source, or all-inclusive source of accident data. However, the available sources can be utilized collectively to give an accurate portrayal of the significance, frequency, and relative magnitude of underwater impacts to other causes of boating accidents in particular and accidents in general. There is no indication that any change in reporting would reflect significant changes in the relative position or percentage of injuries/fatalities due to underwater impacts. Therefore, propeller guarding at best could have only a negligible impact on improving boating safety.

2. Injuries/fatalities caused by underwater impacts result from a person coming into contact with the propeller or any part of the propulsion unit (i.e., lower unit, skeg, torpedo, anti-ventilation plate, etc.) and even the boat itself. Currently reported accidents make it obvious that all such components are involved in the total picture, and that the propeller itself is the sole factor in only a minority of impacts. The development and use of devices such as "propeller guards" can, therefore, be counterproductive and can create new hazards of equal or greater consequence.

3. Operator error is clearly a significant factor in the vast majority of underwater impacts which result in

injuries/fatalities. Mandatory equipment requirements could be expected to have only a negligible impact on this problem. The most rational approach to the problem is to educate boaters, especially operators. They must be made to understand the abilities and limitations of their equipment. They must be aware of and understand the hazards their boat can cause to people in the water. Above all, they must be made to understand the consequences of careless or negligent operation of their watercraft, and how they, as boat operators, can act to prevent accidents.

4. Although the controversy which currently surrounds the issue of propeller guarding is, by its very nature, highly emotional and has attracted a great deal of publicity, there are no indications that there is a generic or universal solution currently available or foreseeable in the future. The boating public must not be misled into thinking there is a "safe" device which would eliminate or significantly reduce such injuries or fatalities.

RECOMMENDATIONS

1. The U.S. Coast Guard should take no regulatory action to require propeller guards.

2. The U.S. Coast Guard should, through improved accident reporting and analysis, develop a complete and comprehensive data base on underwater impact accidents. This should involve, as an integral part, U.S. Coast Guard involvement in the National Electronic Injury Surveillance System (NEISS) and the appropriate training of involved hospital personnel.

3. The U.S. Coast Guard should implement necessary steps to have included in national and state level

educational and awareness campaigns the information regarding potential hazards associated with careless or negligent boat operation. Such programs should be on a continuing basis and be as vivid as possible in depicting underwater impact accident scenarios. These programs should state in a positive manner how such accidents can be prevented by diligent, informed boat operators.

4. The U.S. Coast Guard should work with appropriate voluntary standards making organizations (such as ABYC and SAE) to develop meaningful warning labels, and define their most effective locations, concerning the hazards of underwater impacts.

5. The U.S. Coast Guard should review manufacturing safety standards of watercraft, emphasizing the importance of keeping passengers and operators in the boat, and maintaining the unobstructed fore and aft view of the boat operator.

6. The U.S. Coast Guard should encourage a systematic review of current enforcement programs aimed at reducing boat accidents, and should provide all possible support to implement, maintain and expand those programs targeting the prevention of accidents.

Unanimously adopted by the
Propeller Guard Subcommittee

by /s/ James E. Getz
James E. Getz, Chairman

for: Donald J. Kerlin
Richard H. Lincoln
William D. Selden
Herman T. VanMell

APPENDICES

APPENDIX A .... Charge to the Subcommittee
APPENDIX B .... List of Subcommittee Contacts
APPENDIX C .... List of Documents and Materials Reviewed
APPENDIX D .... Subcommittee Agendas
APPENDIX E .... Failure Analysis Associates Summary
APPENDIX F .... Subcommittee Members

APPENDIX A

Charge to the Subcommittee

APR 13 1988

NBSAC COMMITTEE

Propeller Guards/[Propeller Strikes/Propeller Protection]

Charge to the Committee:

- Review the available data on the prevention of propeller-strike accidents and the Coast Guard study of various methods of shrouding propellers to prevent contact with a person in the water.

- Assess the arguments for and against some form of mechanical guard to protect against propeller strikes reflecting the positions of state boating law administrators, the recreational boating industry, and the boating public.

- Among points to be considered:
  a. what is the incidence of such accidents?
  b. is there a trend toward more or fewer such accidents?
  c. what are the possible solutions and their advantages/disadvantages?
  d. how is this problem being addressed in other nations?
  e. what would be the direct costs and indirect costs (fuel economy, maintenance, etc.) of mechanical solutions?
  f. can the risks be addressed adequately by education?
  g. should the Coast Guard move towards a federal requirement for some form of propeller guard?
  h. assess the potential for propeller equipped with each of several propeller guard designs to cause injury. How much has the propeller guard reduced the injury potential compared to the injury potential of the same propeller operating in an unguarded manner?
  i. should only new boats and motors be equipped with propeller guards, or should all boats eventually be equipped with a guard?
  j. what is the practical boat length limit beyond which propeller guards would not be required? are there other parameters which would dictate upper limits for guard installation?

Committee members:

Jim Getz (Chairman)
William Past
Dick Lincoln
Don Ellison (USCG rep.)

APPENDIX B

List of Subcommittee Contacts

The following list represents the contacts made in behalf of the Subcommittee requesting information relevant to the Subcommittee's charge:

Dr. James Benedict, PhD., M.D.
Biodynamic Research Corporation
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Dr. Albert H. Burstein, PhD.
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Mr. R. Ben Hogan, III
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Principle Engineer – Product Evaluation
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Mr. Robert K. Taylor, P.E.
Managing Engineer
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APPENDIX C

List of Documents and Materials Reviewed

The following is a listing of the documents and materials reviewed by the Subcommittee:

"Prediction of Whole-Body Response to Impact Forces in Flight Environments," by Ints. Kaleps, a paper reprinted from the conference Proceedings No. 253. Models and Analogues for the Evaluation of Human Biodynamic Response, Performance and Protection, North Atlantic Treaty Organization.

"Water Jet Propulsion – Competition for Propeller?," by Ralph E. Lambrecht, Society of Automotive Engineers, Automotive Engineering Congress, No.740283, February 25-March 1, 1974.

"Review of the State of the Art of Swimmer Protection from Outboard Propellers," by Robert Taggart, 16 February 1979.

"Waterskiing Injuries," by Larry R. Pedegana, M.D., and Janice Lang, *The Physician and Sportsmedicine*, Vol. 7, No. 6, 1979.

"Propeller Injuries Incurred in Boating Accidents," by Ronald J. Mann, M.D., *The American Journal of Sports Medicine*, Vol. 8, No. 4, 1980.

Unpublished letter to Mr. Al Marmo, U.S. Coast Guard from Mr. Dick Snyder, Mercury Marine, reference propeller guards, dated December 15, 1980.

"Waterskiing-Related Injuries," by Gregory Hummel, M.D., and Barry J. Gainor, M.D., *The American Journal of Sports Medicine*, Vol. 10, No. 4, 1982.

"Hi-Performance Boat Operation," a booklet published by Brunswick Corp., No. 90-86168 3-184, 1984.

"Steering/Struck-by-Propeller Accident Study, 1983 Recreational Boating Accidents," by Gary Traub, U.S. Coast Guard G-BP-1, December 18, 1984.

Surf Life Saving Training Manual, issued by the Surf Life Saving Association of Australia, 27th Edition (Revised), 1985.

Inflatable Rescue Boat Training Examination and Operations Manual, issued by the Surf Life Saving Association of Australia, Third Edition, 1986.

Coast Guard Memorandum to Chief, Marine Safety Technology Branch, from Chief, Medical Operations Branch, reference Mercury Marine tests, dated June 12, 1986.

"Everything You Need to Know About Propellers," a booklet published by Brunswick Corp., No. 90-86144, Third Edition, 1987.

"The Technological Feasibility of Propeller Guarding for Pleasure Planing Craft," by John G. Hill, February 10, 1987.

"Boat and Propeller Impact Injuries and Fatalities," Project 763584.20 Final Report, by Edward S. Purcell and Walter B. Lincoln, U.S. Coast Guard Research and Development Center, 1 March 1987.

"Motorboat Propeller Injuries," by Charles T. Price, M.D., and Charles W. Moorefield, M.D., *The Journal of the Florida Medical Association*, Vol. 74, No. 6, June, 1987.

"The Feasibility of Propeller Guarding," by Arthur M. Reed, July, 1987.

"Propeller Guarding," a letter report by Lawrence E. Thibault to Mr. Stephen R. Bolden, Esq., dated August 14, 1987.

"Principles of Human Safety," by Ralph A. Barnett and William G. Switalski, *Safety Brief*, Vol. 5, No. 1, Tiodyne, Inc., February, 1988.

Letter to CAPT. Roger T. Rufe, Chief, Congressional Affairs Staff, U.S.C.G., from The Honorable Orrin G. Hatch, United States Senator, reference Mr. Jackson Howard's concerns about propeller guards, dated March 28, 1988.

Letter to The Honorable Orrin G. Hatch, United States Senator, from the Coast Guard responding to Mr. Howard's concerns, dated April, 1988.

Letter to Mr. James D. Martin, Alabama Commissioner of Conservation and Natural Resources, from Mr. R. Ben Hogan, III, reference propeller guarding, dated April 11, 1988.

Letter to Mr. Al Marmo, Chief, Policy Planning and Evaluation Staff, U.S.C.G., from Mr. R. Ben Hogan, III, reference propeller accidents in Alabama, dated May 5, 1988.

Letter to Subcommittee Chairman Getz from Mr. Lars Granholm, National Marine Manufacturers Association, reference 1979 Coast Guard study, dated May 31, 1988.

"Specification Criteria for the Manufacture, Testing & Commissioning of Safety Guards for Use on Inflatable Rescue Boats Engaged in Inshore Rescue Activities, and Schedule of Approved Guards," Bulletin No. 504-88, The Surf Life Saving Association of Australia, National Council, May, 1988.

Slide photographs of various guard devices, components of lower units, and tests submitted by Mr. Richard Snyder, Mercury Marine, submitted August 12, 1988.

Struck by Boat or Propeller manual analysis of 1983-1987 Coast Guard data by Subcommittee member Kerlin, dated September 22, 1988.

Letter to Subcommittee Chairman Getz from Mr. Donald L. Blount, P.E., reference a summary of his presentation to the Subcommittee on September 22, dated October 1, 1988.

Letter to Subcommittee Chairman Getz from Mr. R. Ben Hogan, III, reference propeller guarding information, dated October 6, 1988.

Letter to Subcommittee Chairman Getz from Mr. Dick Snyder, Mercury Marine, reference a summary of his presentation to the Subcommittee on September 22, dated October 6, 1988.

Collection of Propeller guard patents, compiled by Subcommittee member Montgomery, dated October 18, 1988.

Letter to Subcommittee Chairman Getz from NBSAC Chairman Garden, reference NEXUS data bank of published newspaper articles concerning propeller-related accidents, dated October 23, 1988.

Letter to Subcommittee Chairman Getz from Mr. Alex Marconi, OMC Senior Counsel/Litigation, reference response to the article "Motorboat Propeller Injuries" by orthopedic surgeon John Nordt, M.D. of Coral Gables, and other related matters, dated November 9, 1988.

Letter to Subcommittee Chairman Getz from Dr. D.F. Huelke, reference a summary of his presentation to the Subcommittee on November 14, dated December 19, 1988.

Letter to Subcommittee Chairman Getz from Mr. R. Ben Hogan, III, reference his updated article on propeller guarding, dated January 23, 1989.

Letter to Subcommittee Chairman Getz from Mr. Dick Snyder, Mercury Marine, reference a clarification of his presentation to the Subcommittee on September 22, 1988 concerning USCG statistics, dated February 23, 1989.

Photographs of Dr. Thibault's Deposition Exhibits, OMC. ATS Glabman, April 13, 1989.

Letter to Alex Marconi, OMC Senior Counsel/Litigation, from Kelly J. Flood, reference transcripts of Swint and Bruton San Diego Test videos, dated April 17, 1989.

Personal Watercraft Accident Summary, compiled by Subcommittee member Kerlin, dated May 9, 1989.

Letter to Subcommittee Chairman Getz from Mr. Richard Snyder, Mercury Marine, reference a summary of his work with the U.S. Marine Corps delivered at the May Subcommittee Meeting, dated May 30, 1989.

Letter to Subcommittee Chairman Getz from Mr. R. Ben Hogan, III, reference August 9, 1989 stunt man prop guard tests, dated August 11, 1989.

Letter to Admiral Paul A. Yost, Commandant, U.S. Coast Guard, from Mr. Benjamin Kelley, President, Institute for Injury Reduction, reference the Institute's recent news conference and subsequent questions for the Coast Guard, dated August 15, 1989.

Letter to Mr. Benjamin Kelley, President, Institute for Injury Reduction, from Captain W.S. Griswold, U.S. Coast Guard, responding to Mr. Kelley's August 15 letter to Admiral Yost, dated August 23, 1989.

Letter to Subcommittee Chairman Getz from Mr. R. Ben Hogan, III, reference video tapes of a deposition of Dr. Charles Price (08/29/89), propeller guard segment on "CBS This Morning" (08/31/89), and prop guard demo (08/09/89).

Letter to Subcommittee Chairman Getz from the Biodynamic Research Corporation, reference an outline of Dr. Benedict's presentation to the Subcommittee in May, dated September 20, 1989.

Letter to Subcommittee Chairman Getz from Mr. Alex Marconi, reference a U.S. Marine Corps accident involving a propeller guard, with attachment, dated October 12, 1989.

Transcript of the deposition of Dr. Charles T. Price, M.D., dated August 29, 1989, submitted by Mr. R. Ben Hogan, III, November 4, 1989.

Packet of information provided to the Subcommittee by Mr. Benjamin Kelley, November 4, 1989.

Video Tapes, as follows:

Simulated Underwater Limb Impact Tests (SULIT), Mercury Marine, 1988, (21 min.)

Hirsch, Glover, Robinson & Sheiness, Hammonds vs. Yates, Marine Corps Raiders, (4 min.), Guard Operation by Snyder, (4 min.), Mercury and OMC Log Jumps, (4 min.), Ehrhardt Cage Test "Wynne", (6 min.).

Simulated Underwater Flesh Impact Test (Sausage Tests), Mercury Marine, (5 min.).

Chadwell Propeller Device On-Water Tests, Mercury Marine, (8 min.).

Sporting Life IRB's, New Zealand, (25 min.).

March 1989 San Diego Tests, and March 1989 San Diego Tests, Bruton Tapes, Underwater Video, High Speed Film, Speed Runs.

Institute for Injury Reduction news conference release tape, propeller injuries/propguards, June 1989.

Ben Hogan/stunt man propeller guard tests, conducted August 9, 1989 (2 tapes).

Deposition of Dr. Charles Price, dated August 29, 1989.

Propeller Guard segmant [sic] of "CBS This Morning," dated August 31, 1989.

APPENDIX D

Subcommittee Agendas

PROPELLER GUARD SUBCOMMITTEE MEETING
BOSTON WHALER FACILITIES – ROCKLAND, MA
SEPTEMBER 22 & 23, 1988

AGENDA

Thursday, September 22

8:30 AM – 9:50 AM	Subcommittee Welcome, Orientation, and Literature Review
10:10 AM – 11:00 AM	Presentation to the Subcommittee Mr. Richard Snyder – Mercury Marine
11:10 AM – 12:00 PM	Presentation to the Subcommittee Mr. Brian Chadwell – Propeller Guard Designer
1:00 PM – 1:50 PM	Presentation to the Subcommittee Mr. Ben Hogan – Attorney for Advocates
2:00 PM – 2:50 PM	Presentation to the Subcommittee Mr. Alex Marconi – Attorney for Outboard Marine Corp.
3:10 PM – 5:00 PM	Participation with the Subcommittee[:] Previous participants will give points, counterpoints, rebuttals to

other presentations, in addition to questions/answers with the Subcommittee

Friday, September 23

8:30 AM – 10:00 AM On-water propeller guard demonstration[:] Boston Whaler representatives will provide a boat with and without a propeller guard

10:20 AM – 12:00 PM Subcommittee review of newly presented information and plans for the future needs of the subcommittee, with a projected timetable for subcommittee work

The National Boating Safety Advisory Council

PROPELLER GUARD COMMITTEE MEETING
NEW BERN, NORTH CAROLINA
NOVEMBER 14, 1988

AGENDA

1. Presentation by D. F. Huelke. Professor of Anatomy, University of Michigan
2. Review of papers submitted by previous speakers.

   Blount
   Hogan
   Snyder
3. Review of Garden letter, dated October 23, 1988, Re: Nexus.

4. Review of Committee charges from September meeting.

   Getz .....Capt. Griswold letter
   Dr. Thiebault
   Kirlin.....U.S.C.C. Statistical Analysis
   Consumer Product Safety Commission
   David Taylor Model Basin
   Mongomery.....Patents
   Lexus
   Insurance Carriers
   Lincoln .....Robert Taylor Graphs
5. Future Committee Schedule.

PROPELLER GUARD SUBCOMMITTEE MEETING
COEUR D'ALENE, IDAHO
MAY 12 & 13, 1989

AGENDA

Friday, May 12

1:00 – 1:10 PM Review by Subcommittee Chairman

1:10 – 1:30 PM Presentation to the Subcommittee Mr. Richard Snyder – Mercury Marine

1:30 – 3:00 PM Presentation to the Subcommittee Mr. Robert Taylor – Failure Analysis, Inc.

3:15 – 5:00 PM Presentation to the Subcommittee Dr. Lawrence Thibault – Biomechanics, Inc.

7:00 – 9:00 PM	Presentation to the Subcommittee Dr. James Benedict – Biodynamic Research Corporation

Saturday, May 13

8:00 – 10:00 AM	Presentation to the Subcommittee Dr. Albert Burstein – The Hospital for Special Surgery
10:00 AM – 5:00 PM	Subcommittee Review/Report Assignments

August 2, 1989

Captain James E. Getz, Chairman
Propeller Guard Subcommittee
National Boating Safety Advisory Council
Illinois Department of Conservation
110 James Road
Spring Grove, IL 60081

RE: Boating Accident Statistics

Dear Jim:

I am sorry, but I became busy and forgot to send you hard copies of some of the material pertinent to my Propeller Guard Subcommittee presentation. Enclosed are several charts showing accident (Fatality and Injury) statistics reflecting general activities, boating and incidents involving being struck by "boat, propeller, or lower unit." Following are some comments regarding each chart.

Chart 1 "Accident Types" for Fatal Accidents for Boats with Motors 1976-1981

The average number of recreational boating deaths from 1976-1981 is 1,325 per year. Of all fatal accidents for boats

with motors 5.2% of the accidents involve being "struck by boat or propeller."

For the years presented, this amounts to an average of 49 fatalities per year associated with this accident mode. We know this number is higher than actual because we cannot subtract the subset "related to propeller contact" from those accidents where the individual was struck by only the boat or only other motor or steering appendages and not by the propeller. Estimates show that boating fatalities involving the propeller are probably closer to 30 per year.

Chart 2 Annual Fatalities

This chart indicates annually there are approximately two million deaths. The great majority of those deaths are associated with natural causes and disease. Only 5% of all deaths are premature accidental deaths. Nearly half of all accidental deaths involve motor vehicles. One percent of accidental deaths (1384 in 1980) are attributable to boating. Of these, approximately 30-49 incidents per year are associated with propeller involvement. On an absolute basis this is one third to one half the number of fatalities associated with being struck by lighting (94 in 1981).

Chart 3 Risk of Fatality by Activity

This bar chart depicts the relative comparative risk of fatality for various activities. Risk is computed by dividing the number of fatalities for a given activity or accident mode by the opportunities for the accident to occur. In this case, the opportunity is selected as one million exposure hours. An exposure hour is defined as one person spending one hour in pursuit of the activity. In other words, this chart shows the relative risk (or chance of fatality) for different activities if one spent an equal

amount of time (million hours in this case) in pursuit of that activity.

The risk of fatality on a per hour basis while boating, in general, is about one-fourth the risk of operating a motor vehicle and is comparable with the risk of flying in a domestic scheduled airline.

The risk of fatality of being "struck by boat or propeller" is one-third of the risk of traveling in a school bus for an equal amount of time.

Chart 4 Risk of Boating Fatality in 1981

This chart indicates that all boat types do not have the same relative risk of fatality. In fact, boats without motors (inflatables, rowboats, and canoes/kayaks) tend to be substantially more risky than boats with motors.

Chart 5 Rate of Boating Fatalities In Which the Accident Was Described As "Struck by Boat or Prop" 1975-1981.

This chart shows that even motor driven boats without external propellers (jet boats) are involved, on a per-boat basis, in a comparable number of "struck by boat" incidents.

Obviously, this fact demonstrates that in the real world there is no free lunch. Because jet boats have either no or minimal lower steering appendages, they tend to be more difficult to maneuver; consequently, jet boats are involved in collision type accidents. So, in this case, by eliminating one accident mode – propeller strikes – other accident modes have been created or increased – collisions.

Chart 6 Risk of Injury by Activity

This chart shows the comparative injury risk (non-fatal incidents) for various activities. Its derivation is similar to the Risk of Fatality chart. Hospitalized injuries related to propellers while boating or water-skiing are approximately one-half of one percent of the risk of injury while boating or water-skiing.

I would be pleased to elaborate on any of the above issues. If the committee has specific questions they desire to be addressed or if you need further explanation of the background or references for the summary charts, please call.

Sincerely,

/s/ Robert K. Taylor
Robert K. Taylor, P.E.
Managing Engineer
Naval Architecture & Marine Engineering

RKT:dg/getz.doc

Enclosure
Charts (1 orig & 6 Color Copies)

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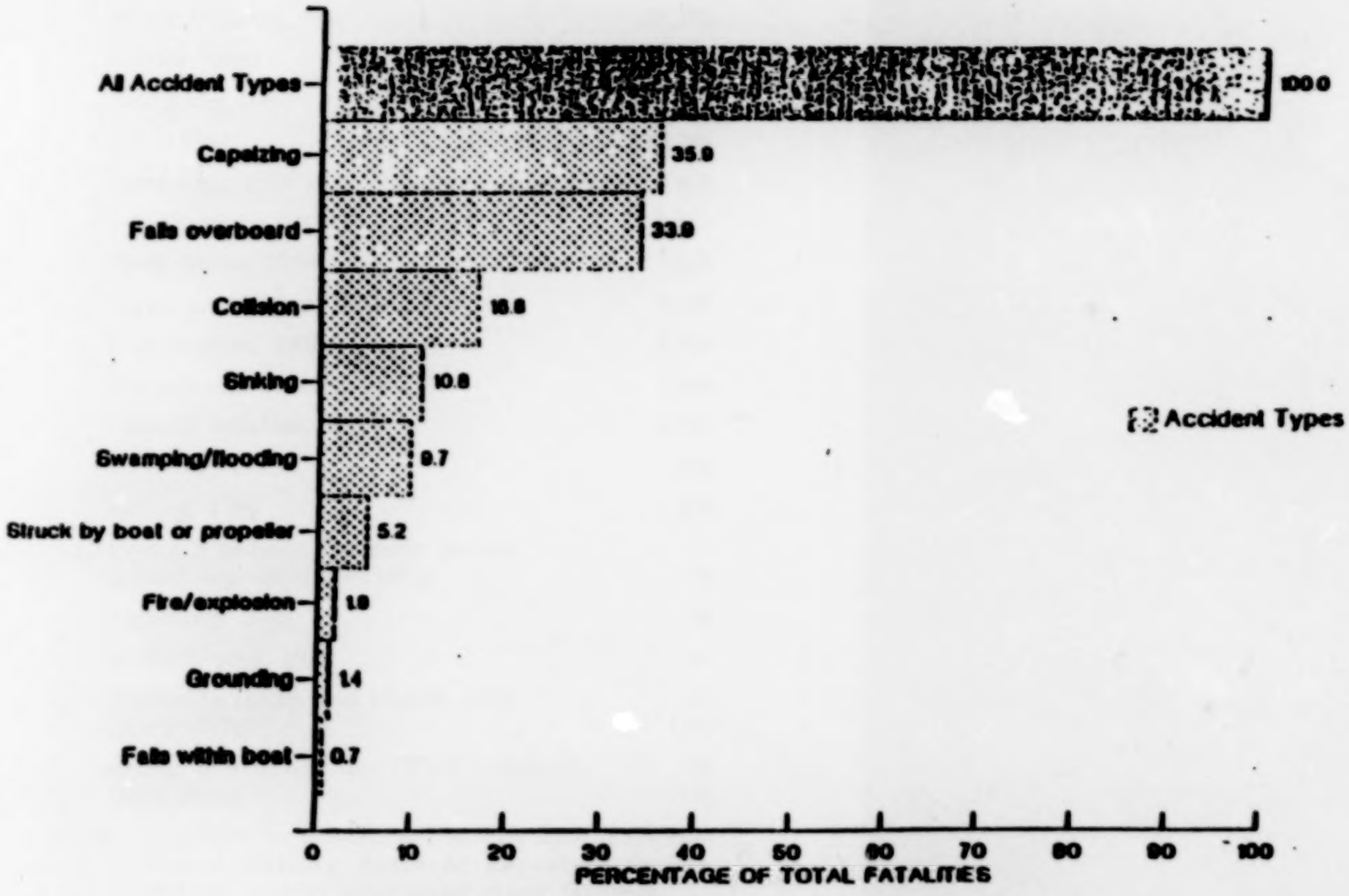
APPENDIX E

Failure Analysis Associates Summary

"ACCIDENT TYPES" FOR FATAL ACCIDENTS
Boats with Motors, 1976-1981



Percentage includes cases with multiple accident types, therefore total exceeds 100%

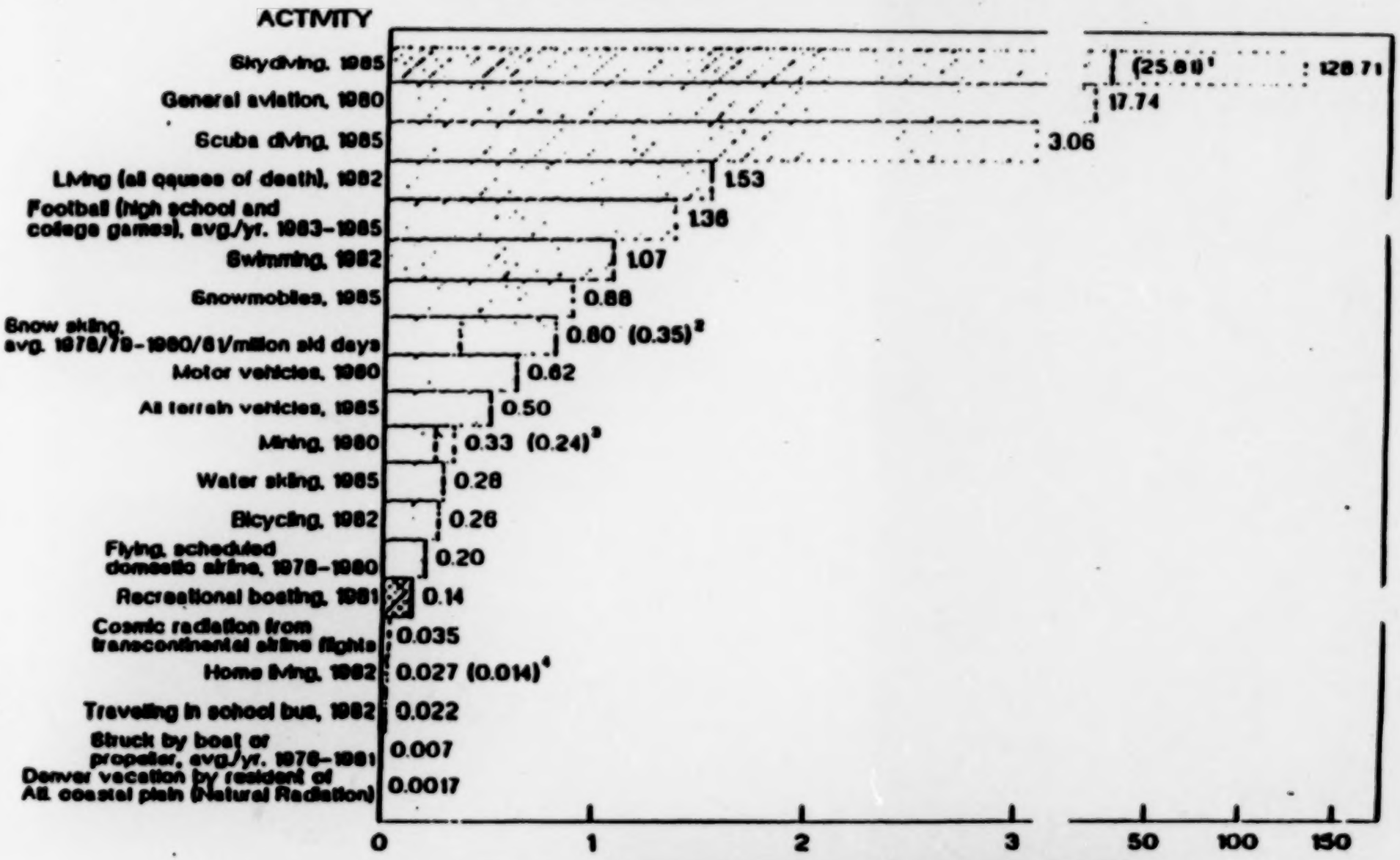
BEST AVAILABLE COPY

ANNUAL FATALITIES

All Causes, 1980	1,989,841
All Accidents, 1980	105,718
Motor Vehicles, 1980	53,172
Suicide, 1980	26,869
Homicide, 1980	23,967
Falls, 1980	13,294
Drowning, 1981	6,404
Swimming, 1981	2,513
Fires, Burns, 1980	5,822
Ingestion of Food, Object, 1980	3,249
Construction, 1980	2,500
Recreational Boating, 1980	1,384
General Aviation, 1980	1,237
Bicycling, 1980	965
Mining, 1980	500
Flying Scheduled Domestic Airline, annual avg. for 1978-1980	98
Lightning, 1980	94
Scuba Diving, 1980	89
Skydiving (Jump and Flight), 1980	47
(Jump Only)	(45)
Skiing, annual avg. for 1978/79-1980/81	37
(Raw Data)	(16)

Note: Fatalities for recreational boating from U.S. Coast Guard Boating Accident Reporting System (BARS), and includes water skiing fatalities.

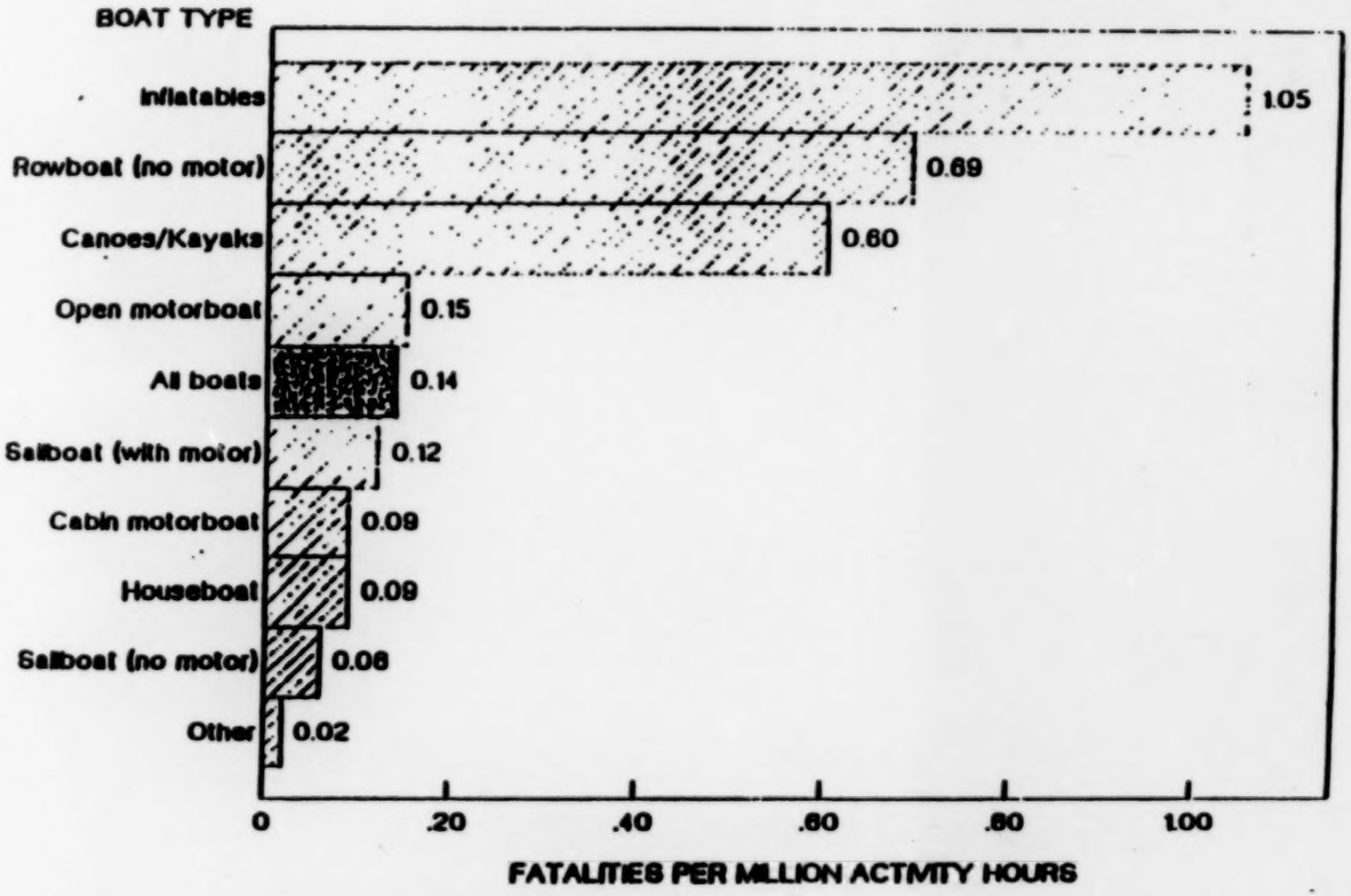
RISK OF FATALITY BY ACTIVITY



Note:
1. The risk for jump time only is 128.71. The number in parentheses, (25.8), is the risk for jump and flight time.
2. The number in parentheses is the risk calculated from the raw data only.
3. The risk for production workers is 0.33. The number in parentheses, (0.24), is for all employees.
4. The risk for active home living is 0.027. The number in parentheses, (0.014), is for active and passive time.
5. Values for some activities may vary from year to year.

Failure Analysis Associates

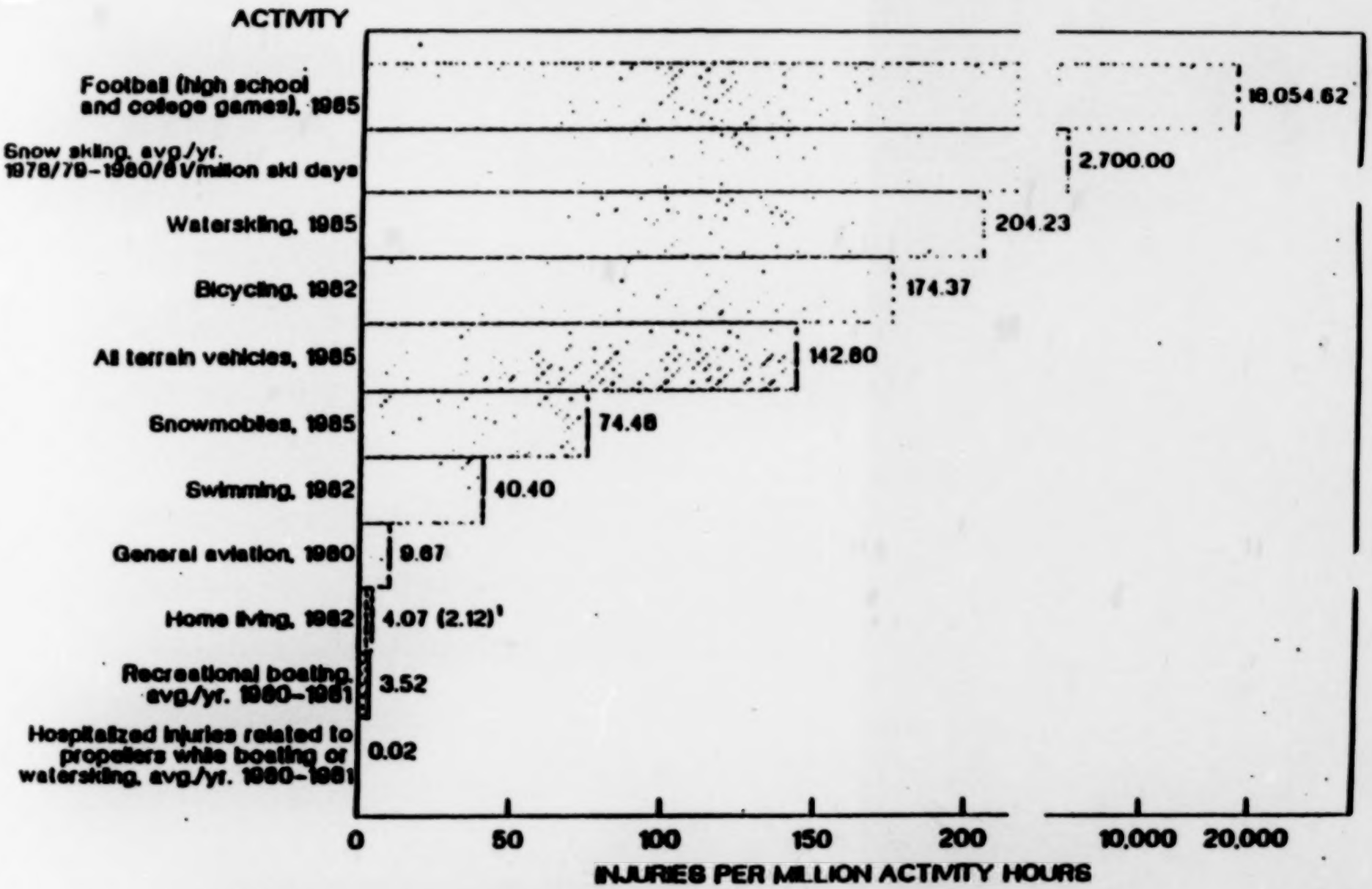
RISK OF BOATING FATALITY IN 1981



Note: Data from United States Coast Guard.

Failure Analysis Associates

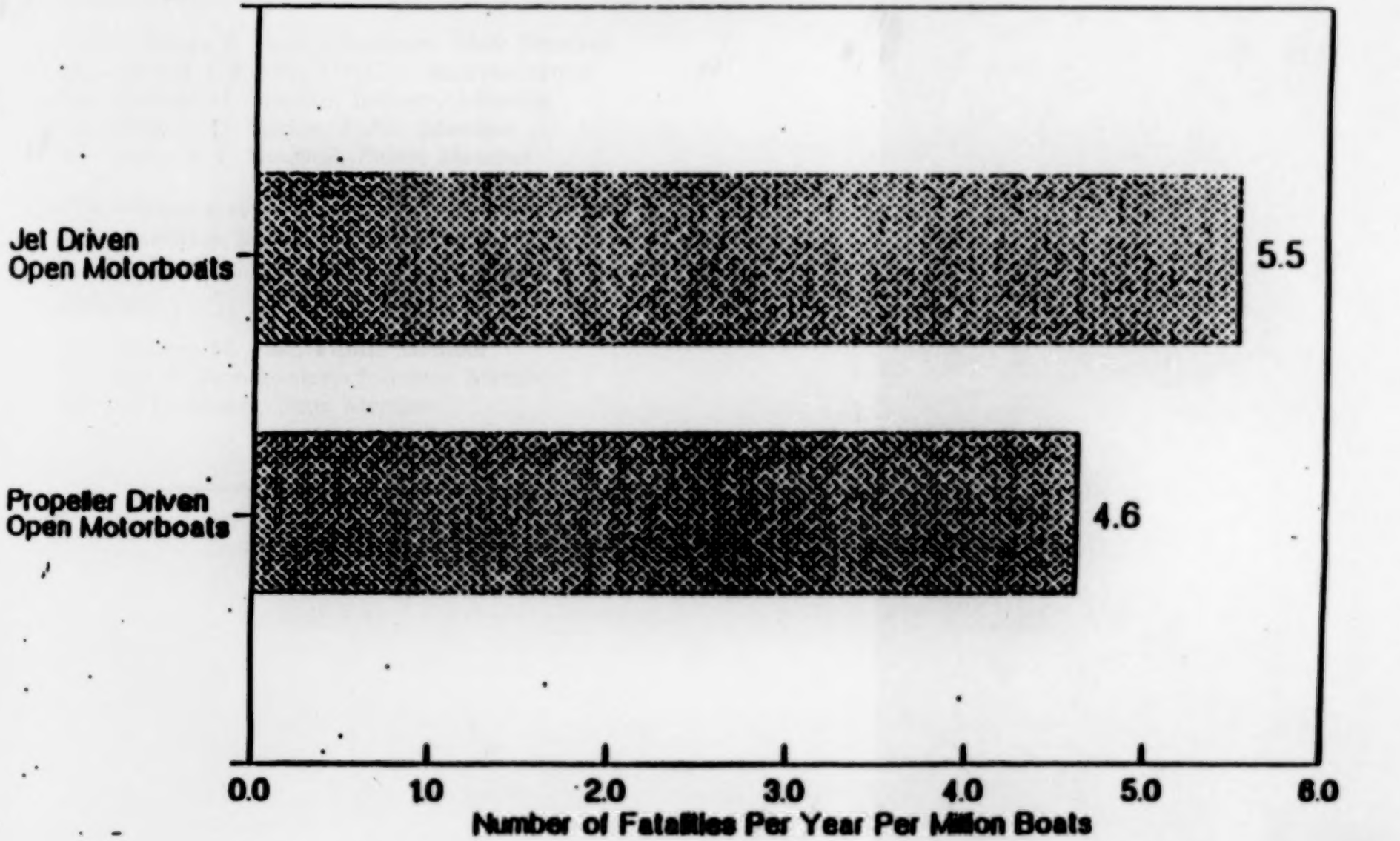
RISK OF INJURY BY ACTIVITY



Note:
1. The risk for active home living is 4.07. The number in parentheses, (2.12), is for active and passive time.
2. Values for some activities may vary from year to year.

Failure Analysis Associates

RATE OF BOATING FATALITIES IN WHICH THE ACCIDENT WAS DESCRIBED AS "STRUCK BY BOAT OR PROP" 1975-1981



APPENDIX F

Subcommittee Members

The following members participated in the Subcommittee's deliberations and consideration of conclusions and recommendations:

CAPT. James E. Getz, Chairman, State Member
Mr. Donald J. Kerlin, U.S.C.G. Representative
Mr. Richard H. Lincoln, Industry Member
Mr. William D. Selden, Public Member
Mr. Herman T. VanMell, Public Member

The following members served at various lengths on the Subcommittee, but were not on the Subcommittee at the time of the consideration of conclusions and recommendations:

Mr. William M. Fast, Public Member
Mr. Roy T. Montgomery, Industry Member
LT. Joe L. Ruelas, State Member

EXHIBIT 6

44th MEETING
OF THE
NATIONAL BOATING SAFETY ADVISORY COUNCIL
LAS PALMAN INN
INTERNATIONAL DRIVE
ORLANDO, FLORIDA
6-7 NOVEMBER 1989

Monday 6 November 1989

0800 – Meeting called to order by Chairman Garden.

A complete record of all Council proceedings is available on audio tape. For further information contact:

Captain W. S. Griswold, USCG
Executive Director
National Boating Safety Advisory Council
U. S. Coast Guard (G-NAB)
Washington, DC 20593-0001

Telephone (202) 267-1077 or Mr. Dean Klinger, Executive Secretary, NBSAC, at (202) 267-0997.

Council Members Present

Mr. A. Newell Garden, Chairman
Mr. John E. Bishop, Sr.
Mr. M. S. Blackistone
Mr. Robert E. Brightbill
Mr. Paul E. Donheffner
COL Donald N. Ellingsen
Ms. Yvonne S. Ferrell
Mr. E. Charles Game
CAPT James E. Getz
Mr. Philip Haseltine
Mr. Richard H. Lincoln
Mr. Robert F. MacNeill
Mr. Roy T. Montgomery
COL David E. Scott
Mr. William D. Selden
Mr. Al Simon
Mrs. Charlotte Toups
Mr. Eric A. Tulla
Mr. Herman T. Van Mell
The Honorable Chandler L. van Orman
LT Michael Vinton

Council Members Absent

NONE

U. S. Coast Guard Headquarters' Representatives Present

CAPT W. S. Griswold, Executive Director, National Boating Safety Advisory Council (NBSAC) and Chief, Auxiliary, Boating, and Consumer Affairs Division, Office of Navigation Safety & Waterway Services; Mr. Dean E. Klinger, Executive Secretary, NBSAC; Mr. Donald Kerlin, Chief, Product Safety Assurance Branch; Mr. Richard Bergen, Chief, Consumer and Regulatory Affairs Branch; LT Randell Sharpe, Merchant Vessel Inspection and Documentation Division, Office of Marine Safety, Security and Environmental Protection; Commander Tom Meyers, Executive Director, Rules of the Road Advisory Council, Office of Navigation Safety & Waterway Services.

WELCOME TO FLORIDA

COL Don Ellingsen, Director, Florida Marine Patrol and Council Member, welcomed the Council and guests to Florida, the Sunshine State.

SWEARING IN OF NEW MEMBER

CAPT Griswold swore in LT Michael Vinton as a new member to fill the unexpired term of LT Joe Ruelas. The new member was introduced as follows:

Lieutenant Vinton was born in Newport, Vermont. He is a graduate of the FBI's National Police Academy.

From 1964 to 1966 he served as a patrolman for the Burlington, Vermont Police Department. In 1966 Mike

became a Vermont State Trooper. His assignments to date include: Governor's Security Detail for three years, Chief Polygraph Examiner for ten years, Station Commander for five years and Marine Division Director for the past five years. He serves as the State Boating Law Administrator.

LT Vinton is a past president of both the Bluch Hill Country Club and the Harwood Youth Hockey Association.

MEMBERS' ITEMS

Chairman Garden relayed his concern about recent advertisements for thrill craft which are small vessels with raised saddle seating, handlebar steering, propelled by powerful outboard motors. The ads also state that these craft are exempt from all Coast Guard construction standards.

Mr. Brightbill remarked that many boat manufacturers are changing Hull Identification Numbers (HINs) on boats that are not sold during a particular model year in order to make them the next year's model. He wanted to know how these boats will be tracked down in the event of a safety recall.

Mr. Donheffner asked if there will be an update on the status of regulations.

Chairman Garden replied that it is on the agenda.

COL Ellingsen said that he is concerned that the current Coast Guard standards for horsepower and capacity only apply to mono-hulled boats under twenty feet in length. He would like them to be expanded to include up to

twenty-four or twenty-six feet in length. He is also interested in hearing about the blue light issue.

CAPT Getz was concerned with the annual funding problems for the Federal Grant Program. He wanted to know if there will be a procedure whereby the Coast Guard and the States each receive the percentage of these funds as prescribed by Congress.

Mr. Haseltine remarked that everyone should be vigilant to insure that the Boating funds are not taken and used for other purposes.

Mr. Lincoln relayed a concern about a past recommendation by the boating safety education subcommittee that the Coast Guard develop a comprehensive boating education plan involving the States, industry and everyone associated with boating. Mr. Lincoln was also concerned about the lack of sufficient funds for the subcommittees to do their work between Council meetings.

Chairman Garden told Mr. Lincoln he shares his concerns on funding.

Mr. MacNeill told the Council that the Rules of the Road Advisory Council's charter has changed. They are now known as NAVSAC. He would like an update on the status of this item.

Mr. Simon told the Council that the State of Maryland recently held dedication services for its first pump out station. He wanted to know if there is a possibility that the Coast Guard will standardize the fittings for pump outs for recreational boating. His other concern is a request for the Coast Guard to standardize buoy colors to indicate speed zones.

Mr. Tulla told about his recent experience with hurricanes in Puerto Rico. He feels it is imperative to educate boaters to evacuate boats during impending hurricanes. He would also like to have access to information as to the proper way to anchor a boat in preparation for a storm.

Mr. Garden informed the Council that last summer Jim Ellis, from BOAT/US, put out some excellent literature on hurricanes.

Mr. van Orman told the Council that one year has passed since the Council passed a resolution recommending that the Coast Guard expand their boater safety education involvement. He would like to know what specific steps the Coast Guard has taken to date, what initiatives it planned to take and what money, if any, the Coast Guard has spent implementing the recommendations of his subcommittee.

LT Vinton said his concerns are the same as those of CAPT Getz.

EXECUTIVE DIRECTOR'S REPORT

CAPT Griswold relayed regrets from Admiral Nelson as he is attending a Coast Guard Flag Conference (all the Admirals) is Gettysburg, Pennsylvania. The Captain reported that his Auxiliary, Boating and Consumer Affairs Division's environment in headquarters has stabilized. His Division's move has been completed and most of his previous concerns of the move have been resolved. Four new employees have been brought on board for the State Affairs Branch. Each one is assigned a NASBLA region and is now working with the BLAs of those States

on their grant program. He is hoping to acquire a secretary for that Branch. The Executive Director said that he has a request in asking for five additional employees. One new position will be clerical, two will go to Hunt Anderson's Education Branch and the other two will go to Don Kerlin's Standards Branch. He feels that recreational boating is bouncing back. He said that Captain Al Rosebrook has been assigned to the Division for a two year period and is now working on special projects and also trying to help the four new State Affairs employees. Captain Griswold informed the Council that $1.5 million has been set aside for non profit grants. He reported that 52 proposals had been received from 27 organizations totaling $6.3 million worth of projects.

Nineteen projects have been selected and he feels that the Coast Guard will be getting some outstanding projects done as a result. One of the grants will go to BOAT/US for an inflatable PFD study. Another will go to the National Water Safety Congress to review and salvage outdated Coast Guard boating safety films. A boating collision study will be done by UL for a grant project. One grant was awarded to compare boaters who took safety courses with those who didn't. Captain Griswold said that managing these grants is becoming a very large burden on his staff and he will need to seek some type of assistance. He said that all indicators point to full funding for the State programs for next year. The Executive Director reported that user fees are still a hot issue and that everything possible is being done to discourage the implementation of them. He reported that there is a possibility that accident fatalities are running slightly ahead of last year's pace. He hopes that with the increase in the

number of boats, the rate will not rise. He commended the Council and other organizations for attaining this excellent boating safety record. Speaking on Blue Lights for the Auxiliary, the Captain explained that the law enforcement community was opposed to the Coast Guard's proposal to test the use of these lights for Auxiliary vessels. The tests were called off prematurely basically because many authorities want to keep blue lights to identify law enforcement vessels only. The possibility of using an orange/red flashing light for special events by Auxiliarists is now being looked into.

COL Ellingsen told the Captain that he thinks the Auxiliary will get plenty of support for an Orange/Red light, anything but Blue.

CAPT Griswold reported that the Coast Guard will conduct a trial project that allows inflatable TYPE I PFDs to be carried on certain commercial vessels. The Executive Director proposed to the Council that a subcommittee be formed to look over the operation of Consumer Affairs and Product Assurance in his Division. He stated that the Commandant has formed a special task force to review the Coast Guard's boarding procedures. He congratulated the BOAT/US Foundation for coming up with over $35,000 for 19 groups to gather information. National Safe Boating Week, which was held the week of June 4, 1989, will be reported on by Bill Ladd. The Captain reported that the Coast Guard Auxiliary was able to do a Courtesy Marine Examination (CME) on the President's personal boat, "Fidelity". The entire procedure was videotaped and portions will be used as public education promotional spots. Captain Griswold announced that the Auxiliary had just celebrated its 50th anniversary this summer.

They appear hale and hearty and ready for another 50 years of work. He also said that the United States Power Squadrons just celebrated their 75th anniversary by flying their flag in a space shuttle as well as all around the world. He reported that some recreational boating safety hearings were held before the House Merchant Marine & Fisheries Committee's Subcommittee on the Coast Guard and Navigation last May. The purpose for the hearings was two-fold. First they received testimony from Federal, State and local representatives on budgetary concerns about funding of the Boat Safety Account as well as comments on the Administration's proposal for user fees on commercial vessel operators and recreational boaters. Other organizations registered their strong opposition. Secondly, the Subcommittee addressed safety concerns such as boating while intoxicated, boater safety education, personal flotation devices and personal watercraft issues. Some other issues that were brought up were carrying passengers for hire, Coast Guard boardings, numbering all vessels and defects. The meetings were chaired by Subcommittee Chairman, Congressman Billy Tauzin and attended by Congressman Bob Clement.

RADM William Eckert, commander, 2nd Coast Guard District, was accompanied by Commodore Bill Schulte, Coast Guard Auxiliary and Mr. (illegible) Marmo from Headquarters as Coast Guard witnesses. The Army Corps of Engineers was represented on the Federal panel. There was also a State panel, National Organization panel, Industry panel, and a Waterways Operations panel. The Captain reported that there are now 34 States with a Blood Alcohol Standard. He added that Maine joined

Utah this year with a BAC level of .08%. A copy of the summary of State BAC Laws is attached as Enclosure (1).

NEXT MEETINGS

CAPT Griswold announced that the next Council meeting, no. 45, will be held in Denver, Colorado on May 12-15, 1990. Subcommittees will meet on Saturday the 12th and the full Council will meet Monday & Tuesday, 14 & 15 May, 1990. Meeting number 46 has been tentatively scheduled for November 10-13, 1990 in San Diego, California. Both meetings will be held over weekends in order to allow members to utilize the lower air fares.

Mrs. Toups informed the Council that the Coast Guard began its 200th year of service on August 4th of this year. She also stated that Congressman Tauzin is a recreational boater and is a very good listener.

Mr. Game stated that he had hoped to hear more on the impact of the new MARPOL regulations on the recreational boaters, especially as it affects the discharge of garbage. He was also concerned about the September 15, 1989 Federal Register Notice on proposed Vessel Identification Systems.

CAPT Griswold reminded the Council that it had been briefed on that project at the previous meeting and progress is being made. The public comment period will close on December 14, 1989.

UPDATE ON NATIONAL BOATING SURVEY

Dr. Susan Blake, Project Manager, American Red Cross, gave the Council a status update on the national boater survey that she is conducting. The purpose of the survey is to provide reliable, useful information on boating safety that will be of use to educational planners. The objectives were to provide national estimates of the number of boats and the number of boaters that exist in the country, boating exposure (types of activities, which waters and how long people are boating per year). She is also trying to get a handle on critical incidents which are not only accidents but also near misses that are life threatening. Dr. Blake told the Council that she wants to do a comparison on boat sizes and boat types as well as to get a full set of demographics to help understand more about the boater. She also expects to collect information to verify that the Coast Guard is receiving reports on about all of the fatal accidents but only about 10% of those required to be reported property/injury accidents. The present survey results will be checked with survey results from 1973 and 1976 for comparability. She said that this survey is being conducted by using random sampling. The two previous surveys contacted boating households only. The goal is to survey 5,000 households. To date about 600 have been contacted.

Mr. Lincoln asked if this is a telephone survey.

Dr. Blake replied "yes, a random survey by phone".

Mr. Lincoln asked if any results are in yet.

Dr. Blake said "not yet, its still too early".

Mr. Lincoln asked how long it is expected to take to complete one interview.

Dr. Blake answered that the full survey takes about 35-38 minutes to complete.

Mr. Ladd asked how the accuracy of 5,500 interviews can be compared with the accuracy of 25,000 interviews in the previous surveys.

Dr. Blake replied that about 25,000 people will be screened in order to get 5,500 households for the complete set of questions, which would compare with previous surveys.

CAPT Getz asked when the survey will be completed and what is the planned distribution of the written results.

Dr. Blake responded that interviews will continue into December. It is expected to take several more months to complete the written report and final distribution will be left up to the Coast Guard to decide.

Chairman Garden asked how many people at the meeting were asked to look at a preliminary copy of the survey questions. (Three hands were raised, making it a total of four including himself).

COL Ellingsen asked why boating registration lists are not being used to contact boaters for this survey.

Dr. Blake explained that by doing so it would become a biased survey because the States do not all have identical registration laws. Some require all boats to be registered while others only require motorboats to be registered.

NAVIGATION LIGHTS SUBCOMMITTEE REPORT

Mr. MacNeill, Subcommittee Chairman, informed the Council that his committee's charge was to determine whether or not the change to Rule 23 of the COLREGS, to permit the masthead light to be located aft of amidships on recreational power vessels, could be made without adversely affecting navigation safety. The subcommittee was to consider: (a) problems with complying with current regulations, (b) safety problems with current masthead light locations and (c) alternative masthead light placement that would solve the physical mounting problem, solve possible glare problems and provide visibility intended by COLREGS. He said it has been demonstrated that nearly all major boat manufacturers ignore the light placement portion of this treaty. Talking about safety problems he said that there are two questions remaining to be answered. They are, (1) will allowing a masthead light moved aft of amidship affect one's visibility to distinguish the size and aspect of another boat? and (2) Exactly how much does the glare and backscatter affect one's ability to see ahead of his or her vessel at night? Specifically, (a) Can we see the light on an aid to navigation better without a forward masthead light on, and if so, by how much? (b) How much is our dark-adaption (night vision) affected by the glare and scatter of the forward masthead light? If it is affected, how much has it affected our ability to see another vessel or a navigational aid at night? Mr. MacNeill said the subcommittee cannot answer these questions because it lacks the necessary expertise. Therefore, he has requested funding to continue research efforts. In response to this request, assistance from the Coast Guard's R & D Center is being

sought. The Center has a vision scientist on board who will do a study in Spring. Mr. MacNeill feels that some of this research on glare has already been done and could possibly be found by a competent literature search at a cost of about $5,000. He feels that a change in the navigation rules (COLREGS) must take place to correct part of this problem. The next IMO meeting will be in September of next year. It is the Coast Guard's responsibility to request agenda items through the Department of State. Therefore, the subcommittee recommends that the Coast Guard: (A) Attempt to rearrange the R & D Center's priorities to provide the research necessary prior to the May NBSAC meeting and (B) Secure funding to perform a proper literature search.

Mr. MacNeill reported that he had taken the NBSAC resolution to the RORAC meeting and got the following response from their chairman.

1. RORAC has considered NBSAC's proposed resolution of May 11, 1989 and the additional information provided at its meeting on Wednesday, November 1, 1989.

2. The Coast Guard is proceeding with its research and development studies of the safety concerns raised by the proposed resolution. RORAC will await the results of these studies before making recommendations as to whether or not existing COLREGS and Inland Rules should be changed. These results should be available to RORAC by the time of its next scheduled meeting in May, 1990.

3. RORAC presently does not accept the validity of many of the assumptions and suggested technical conclusions used as a basis for the actions being recommended by NBSAC.

4. Pending the receipt of the results of research & development studies RORAC has requested the Coast Guard to seek information as to what other countries are doing with permits which permit the construction and use of recreational vessels in violation of COLREGS Rule 23(a)(i). Likewise RORAC encourages NBSAC to explore its formal and informal channels to foreign manufacturers to seek to develop similar information.

5. When this issue subsequently comes before RORAC, it will attempt to consider all relevant factors including in this case, perhaps, the international competitive market. However, RORAC's recommendations ultimately must stem from consideration of safety and not merely aesthetics.

6. RORAC believes that in the case of vessels 20 meters in length or longer, the factor of navigation safety far outweigh any other consideration and dictates that a masthead light be displayed *forward* on such vessels. Therefore, even if RORAC ultimately determines to recommend that the U. S. proposes to IMO an amendment to the COLREGS such amendment should be limited to vessels less than 20 meters in length. Accordingly, it is not envisioned that any amendment to Inland Rule 23(a)(i) will be required.

7. This committee recommends that this proposed response to NBSAC be adopted as a RORAC resolution (it was).

8. Unanimously agreed: That Certificate of Alternate Compliance (CAC) procedures are not applicable to pleasure or recreational type vessels solely on the basis of style, design or marketability. (This is based on the long-standing language and intent of COLREGS Rule 1.)

Mr. MacNeill recommended that his committee should continue working on the perceived light problem and not turn it over to RORAC because they only deal with problems of commercial shipping and do not fully recognize the needs of the millions of recreational boaters. He did recommend that future subcommittee meetings have participation by representatives of RORAC.

The Committee recommends:

A. That the Coast Guard adjusts the R&D Center's project priorities so that an appropriate glare study can be performed prior to the May NBSAC meeting; and

B. That the Coast Guard fund an independent literature search on the subject of degradation to dark adaption or night vision from backscatter from a masthead light and direct glare from an all around white light. (The two research efforts should be completed prior to the next NBSAC meeting in May, 1990 so that the problem can be taken to IMO.)

C. That the Coast Guard establish a joint NBSAC/NAVSAC navigation light committee and arrange for a meeting after the results of the research are known and prior to the scheduled May NBSAC/NAVSAC meetings.

D. That the Coast Guard request the Department of State to put the navigation light issue on IMO's agenda for their September meeting.

COL Ellingsen commended the subcommittee on their outstanding report and said that he strongly recommends that they continue their work.

Mr. Game told the Council that it is very important to keep this as a priority project, not only in the Coast Guard, but also with NBSAC.

CDR Meyers, Executive Director, Rules of the Road Advisory Council (RORAC) told the Council that his Council would be the appropriate one to act upon this item. He stressed the fact that RORAC does not only represent commercial shipping. It is well balanced and does consider recreational boating concerns.

Mr. Lincoln said he is not aware of any members on RORAC that are representatives of the recreational boating industry.

MOTION: That the Council concurs with the subcommittee's report.

VOTE: – IN FAVOR – UNANIMOUS.

SUBCOMMITTEE ON ACCIDENT REPORTING

COL Ellingsen Subcommittee Chairman, told the Council that his group met on Saturday afternoon to discuss several items. The original charge to the subcommittee was to review the present procedure for reporting accidents by consulting with NASBLA and others in the reporting chain. After considerable discussion with the committee and NASBLA's BAIRAC (Boating Accident Investigation, Reporting and Analysis Committee), it was decided that the major insurance carriers could be most helpful in attaining more accurate information. To date these two committees have been unsuccessful on this matter. He said that Captain Griswold has appointed a retired insurance executive, who is a member of the Coast

Guard Auxiliary, to work with the industry. COL Ellingsen told the Council that a letter had been sent, along with a questionnaire, to the American Institute of Marine Insurance Underwriters on June 23, 1989 signed by both himself as chairman of this committee and Mr. Jim French who chairs NASBLA's BAIRAC. The letter pointed out the problem to the association and asked for their assistance by basically not handling a marine claim unless it has been properly reported to the government. He said that the industry did not accept the recommendations as they had hoped they would. However, there is a little light at the end of the tunnel as this subject will be further discussed with the industry prior to the NASBLA meeting in New Orleans in December. He said that the American Institute of Marine Underwriters represents approximately 20 insurance companies which, in turn, represent about 80% of the entire boating insurance business. He said that most marine surveyors have been informed about the State and Federal accident reporting requirements. He briefly described the seminars that are being conducted by Underwriters Laboratories for marine accident investigators. The Colonel remarked that the States are being encouraged to investigate as many boating accidents as possible. He said proper analysis of accident information is necessary in order to have proper corrective measures taken. COL Ellingsen said that he has had seven personal watercraft accidents investigated so far this year in Florida. Six were fatal and one resulted in serious injury. He reported that UL has also been given a grant to conduct further research into accident reconstruction to basically acquire a data base for an accident investigator to use. He mentioned that UL is also doing a

poster campaign pointing out that there is a law requiring that boating accident reports be properly filed. He concluded by recommending that the subcommittee be discharged at this time even though its final report will not be written until after the upcoming meeting with the insurance executives.

CAPT Getz suggested that it would be better to just declare the subcommittee inactive until such time as the final report is issued.

MOTION: That the subcommittee report be accepted and that it be declared inactive and subject to recall.

Chairman Garden declared the motion unnecessary as the subcommittee is planning to give its final report at the May 1990 Council meeting.

Self introduction of guests. List is attached as Enclosure (2).

BREAK

REVIEW OF DEVELOPMENTS IN PFDS

Mrs. Susan Balistreri a consultant in the field of PFDs and the founding chairman of the Personal Flotation Device Manufacturers Association, briefed the Council on the manufacture and marketing of PFDs. She explained the evolution from the original method of manufacturing and approving of PFDs to the present day system. Originally all the details of manufacture were spelled out in the Federal Register for the TYPE I device as were the details for the TYPE II device when it became available. When the TYPE III device originally appeared it was only acceptable as excess gear on board pleasure boats. She

said that it was after the passage of the Federal Boat Safety Act of 1971 that standards for Personal Flotation Devices became performance oriented and the Underwriters Laboratory Marine Division was formed. She told the Council that part of her job as a consultant is to help manufacturers improve the performance of their PFDs. Mrs. Balistreri remarked that it is the placement of the buoyant material rather than the total amount of buoyancy that affects the performance of PFDs. She said that any flotation material that is above the waterline of a person is useless.

With the help of her daughter, a variety of PFDs were displayed and their features were explained. She reported that her association is presently engaged in what should be a partnership with the boating community by printing pamphlets and brochures to help educate the consuming public concerning PFDs. It is her belief that customization of various devices will be the way of the future.

Ms. Ferrell asked if the color orange as a visual indicator for PFDs has been replaced by other considerations.

Mrs. Balistreri replied that the original International Orange colored units were designed for offshore boating where there is a need for a device reliable enough for long term rescue. This color has been compromised for inland boating to allow the devices to be more eye-appealing and in turn be worn more.

Mr. Game told the Council that he had a hard time trying to purchase ski vests of a contrasting color for his family.

Mrs. Balistreri answered that the manufacturers certainly do not discourage orange or yellow ski jackets, its just that people prefer to buy other colors.

Dr. Blake asked if the industry ever tried to make PFDs with the new reflective colored materials.

Mrs. Balistreri replied "Yes". However, there are Coast Guard UV (Ultra-Violet) requirements which have to be met and to date none of these materials appear to meet them. The industry is currently working on this.

Mr. Blackistone remarked that the industry should push the safety aspect of having contrasting colors on ski vests in the pamphlet and other marketing methods.

Mrs. Balistreri assured the Council that she would relay the information to her association members.

Mr. Game remarked that "safety" can be and should be a sales feature.

Mr. Selden said that he feels that we are on the right track. However, wearability must be the highest priority.

Mr. Haseltine told the Council that research has proved that older persons have a harder time differentiating between colors than young persons.

Mrs. Toups told the Council that everybody is right. She stated that hunters will absolutely not wear an orange PFD over camouflaged hunting clothing.

Mr. Tulla remarked that a toddler wearing a blue collared PFD is extremely hard to spot in the water. He would hesitate to even think about selling that color because of safety concerns.

STANDARDS UPDATE

Mr. Donald Kerlin, Chief, Product Safety Assurance Branch, told the Council that the proposed manufacturer/dealer first purchaser regulation has been underway since 1977. This regulation would now require dealers to participate in obtaining information on the first purchaser in order to help the manufacturer to maintain an accurate list to be used for notification in the event a safety defect recall is necessary. He said that the reason progress has not been made on this project is because of the paperwork reduction program. A subsequent Inspector General's Report chided the Coast Guard for the seemingly low percentage of first purchaser notifications in the event of a safety defect recall campaign. He said that the manufacturers blame this poor notification on the fact that dealers are not required by law to forward first purchaser information to the manufacturer. Additionally, comments were also received from the Government Accounting Office (GAO) on this project. A supplementary Notice of Proposed Rulemaking was published and drew a large number of negative comments on the proposed changes. He said that using a Vessel Identification System for recall purposes will not be possible for several years. Mr. Kerlin remarked that by using a Coast Guard/State registration system, only owners of boats required to be numbered would be included. A system would have to be devised to track owners of unnumbered boats, motors and sterndrives. The other alternative is to continue with the project as written. If this method is chosen it will be necessary to address two problems. (1) Inflatable boat manufacturers (mass merchandisers and importers) and (2) Trolling motors. These groups feel that the

proposed regulations are too burdensome and costly in relation to their products. Additionally, the total paperwork requirement may be too burdensome to meet current standards. Mr. Kerlin asked the Council if they feel that some inflatable boats and battery powered trolling motors could be exempt from the proposed first purchaser regulations.

Mr. Haseltine asked what types of boats are involved in most recall campaigns.

Mr. Kerlin answered that most recalls involve boats in the 16-18 ft. length category. He said that to the best of his knowledge there has never been a recall involving either inflatables or trolling motors.

Mr. MacNeill remarked that care must be taken in differentiating between construction material for inflatables.

Mr. Montgomery said that he would recommend that any boat designed to be powered by a motor should be included in a first purchaser regulation.

Mr. Donheffner asked about the scope of the current first purchaser regulation.

Mr. Lincoln informed him that it covers boats, outboard motors, and stern drive units.

Mr. Kerlin said that he got the feeling that the Council agrees with excluding trolling motors but feels that extreme care must be taken in further regulating the inflatables. He will be expecting a firm proposal from the Council at the next meeting.

Mr. Kerlin continued his presentation by informing the Council that there are no new standards in the offing. He

introduced Mr. John Hannon from the Merchant Vessel Inspection Division at Headquarters, as the liaison person between the offices of "M" and "N". It is Mr. Hannon's office that coordinates the field offices that are charged with the factory visit program. A comprehensive report on factory visits should be ready by the next Council meeting. He also introduced Greg Shafer from Tampa and Dave Gaul from Jacksonville as members of the Coast Guard's current marine safety program.

Mr. Lincoln spoke briefly about the required use of "Certified" mail to notify the first-purchaser in the event of a safety defect recall campaign. He said that he realizes the industry did not come up with sufficient justification to change the current regulation, however, he still does not like it.

Mr. Kerlin replied that it's not a totally dead issue. He's still waiting for information from the industry to further pursue it.

Mr. Montgomery told the Council that his company's experience shows that "Certified" mail is just not working because too many are being returned as undeliverable.

Mr. Lysle Gray informed the Council that several years ago the Coast Guard legal office rendered an opinion that without the use of "Certified" mail there would be no proof of attempt to notify a customer about a safety recall. He said that a company could send out notification using regular mail and in the event of no response at that point use "Certified" mail.

Mr. Kerlin spoke briefly on the updating of "Subchapter T". He said that in addition to receiving numerous written comments, the Coast Guard also held six public hearings. These comments are being considered and a Supplemental Notice of Proposed Rulemaking will be issued around September, 1990. He will try to have a status update for the May meeting in Denver.

Mr. Game suggested that a person be appointed to follow progress on this subject.

Mr. Donheffner asked if any progress is being made on deleting the acceptance of the TYPE IV PFD.

Mr. Kerlin replied that he will look into it.

Mr. Lincoln told the Council that he feels that someone should be actively studying the safety facts of alcohol blended fuel upon the marine industry.

Mr. Kerlin assured the Council that the Coast Guard is actively monitoring this subject and will keep it advised if any developments take place.

LUNCH

PLANNING FOR THE FUTURE OF BOATING EDUCATION

Mr. Hunt Anderson Chief, Boating Education Branch, told the Council that education has been an evolutionary process and he hopes it will continue to be so as far as boating safety is concerned. He said that the fact that there are not only more boats in use but there are also more powerful boats in use indicates that boating education must be altered in how we contact people. Mr.

Anderson said that he is tasked with managing what some people refer to as the National Boating Safety Education Program. He works with Federal Government agencies such as the Army Corps of Engineers, NOAA, FTC, Park Service and the Fish & Wildlife Service, etc. He also works directly with 35 national non-profit organizations, a good number of the States, academic institutions and the industry. He said that the past philosophy has been that anything is better than nothing. However, he is now trying to get better organized. There is a core of basic boating information that is taught as a part of most operator training whether it is for:

> Public education programs taught by a State or a nonprofit organization, like the Coast Guard Auxiliary or the U.S. Power Squadrons,
>
> Vessel operator qualification courses like the Army Corps of Engineers is developing.
>
> Marine law enforcement training programs such as the National Boating Safety Course offered at RTC Yorktown and those offered by some States.
>
> Train the trainer programs for the instructors of any of the above programs.

There is a need to enhance the training aids used to teach this basic core information. We are trying to encourage different parts of the boating community to develop training aids for different subject areas within the core. At this time there are a few grant programs and joint venture projects between the Coast Guard and industry that are beginning to yield some useful training videos. The Boating Education Branch is trying to act as a clearing house and point of contact for technical review of these efforts.

He added that it is necessary to avoid duplication among the different organizations involved with boating education. Mr. Anderson explained the use of grant guidelines to avoid pitfalls in the Coast Guard's grant program. It is intended to have the finished grant products adaptable so that, with minor modification, they can be used for several audiences. A better quality product is the bottom line.

Mr. Montgomery asked is there is a document presently available which can be used to evaluate a grant.

Mr. Anderson replied "yes" but it is not ready for general distribution.

Speaking on new educational products, Mr. Anderson mentioned the U.S. Power Squadron's new video boating course.

Mr. Selden (Chief Commander, USPS) described the new program which was started on May 1, 1989 and is now in the marketplace. It is an 80-minute video covering their 6-lesson boating course, which is really their 12-session course which was compressed and had radionavigation added. A 240 page book is included in the package to cover items that are not conducive to video. This program is designed to be comprehensive enough so a person who either uses the tape or attends the 6-session class should be able to pass the examination for qualification. The price of producing this package was $450,000 with no cost to the Power Squadrons. The package is being sold for the retail price of $39.95. The film was recently the winner of the gold medal at the Chicago Film Festival. Additionally, the package does meet the standards of the National

Association of State Boating Law Administrators' model course on boating education.

Mr. Anderson told the Council that the Corps of Engineers has a training program to certify their employees as boat operators. In the area of joint adventure projects, he mentioned that the Kilgore Corporation has done a project on flares that can be used in the classroom. He also praised the Kawasaki Corporation for producing and distributing a video on personal watercraft safety. He said that the National Water Safety Congress will review all available boating safety films and catalog them with comments as to their usefulness. He concluded by saying that he has the results of an anchoring study and will try to put the information into a readable pamphlet.

REPORT OF THE PERSONAL WATERCRAFT SUBCOMMITTEE

Mr. Blackistone, Subcommittee Chairman, told the Council that his subcommittee was charged to look at a number of items related to personal watercraft. The basic question that was looked at was whether the Coast Guard should come up with new regulations or if it should be left to the States to regulate these craft. He reported that over 200,000 of these units are now in use and their popularity is increasing rapidly because the consumers believe that they are fun. Mr. Blackistone reported that to date all of the units in existence seem to be good quality products. The current problems seem to be linked to the operator side of the issue. He said that personal watercraft are a target of the media because they are good press and a target of the residential community because

they are annoying. Both of these issues are growing. He believes that there are three dimensions to the personal watercraft: The owner, the renter, and the borrower. He remarked that the average unit is used by as many as five or more different people.

The subcommittee delivered the following recommendations:

1. That the Coast Guard should continue to encourage and support educational initiatives including print, visual, and audio as well as PSA's to targeted groups.
2. That the Chairman of NESAC communicate with the president of NASELA the importance that accidents be analyzed for involvement by owners, renters and borrowers of personal watercraft with the goal of targeting that audience. In addition the NASBLA should be encouraged to include material on personal watercraft in their State boating program. Another recommendation would be that NESAC concurs that the minimum age for operating these units should be 16 years.
3. That the Coast Guard should continue to encourage reciprocity between States on these craft and that the Coast Guard should be flexible in its requirements for numbering to insure maximum visibility of numbers on personal watercraft.
4. That the Coast Guard should amend their regulations to exclude TYPE IV PFDs for personal watercraft users and require operators and passengers to wear an approved PFD.
5. That the personal watercraft regulation and legislation be relegated to State and Local jurisdictions.
6. That the Coast guard's Consumer and Regulatory Affairs Branch and the Personal Watercraft Industry

Association serve as a clearinghouse for personal watercraft initiatives on the State and local level. The NBSAC Chairman should continue to communicate with the president of NASBLA and that youth age requirements should be a State function.

7. That the subcommittee be placed in an inactive status with the possibility of being reconvened at a later date.

Mr. Blackistone thanked Dick Bergen for his role as the Coast Guard representative and Roger Hagie from Kawasaki and the Personal Watercraft Industry Association and Nancy Linden from NHMA for their tremendous help.

MOTION: That the Council concurs with the foregoing recommendations as presented.

VOTE: In Favor – Unanimous.

The Subcommittee's complete report may be attained from the Council's Executive Secretary.

REPORT ON THE 1989 NATIONAL SAFE BOATING WEEK

Mr. Bill Ladd explained that National Safe Boating Week is when a year-round boating safety effort is kicked off. He said that this year's efforts have been focused on the small boats because about 54% of the boats in the U.S. are under 16 ft. in length. This year's subjects are limited to stability, alcohol, PFDs, weather, float plans and hypothermia. He believes that the only way to reach the boating public is by utilizing the general media and the dealers. He reported that over one million items were distributed in conjunction with this year's campaign. Mr.

Ladd concluded by urging the Council members to offer their suggestions for next year's program to Mr. Dick Bogue who is the incoming chairman.

BRIEFING ON BOATING SAFETY AT WALT DISNEY WORLD

Mr. Wayne Mitchell, Safety Department Director, Walt Disney World, briefed the Council on the history of his place of employment. He said that there are 27 miles of waterways and canals on the property consisting of 43 square miles or 27,000 acres. A part of Disney's plan was to create an aquatic wonderland where people could do just about anything water related and do it right. Mr. Mitchell reported that the Disney fleet is the fifth largest navy in the world in terms of number of craft. These craft run in size from small rental units to 600 passenger ferry boats. The majority of their fleet consists of small water sprites which are equipped with 9.9 HP outboard engines and are part of the rental fleet. He remarked that over 200 Disney trained pilots are employed to operate the transportation craft which carry from 45 to 600 passengers. He said that they are not bound by State or Federal boating regulations because they operate on private property. He added, however, what is a law for the rest of the world becomes a standard for their operation and non-compliance with a standard can be just as costly as violation of a law. There are 11 patrol boats with highly trained personnel utilized to keep watch over the rental fleet. The patrol officers are trained so as not to come down on operators heavy handedly, but to kill them with kindness. Mr. Mitchell explained that prop guards are used on the 9.9 HP outboard engines to help lessen the impact in the event of

a certain type of accident. Experiments using larger motors with prop guards showed that it was almost impossible to control direction of the craft. Additionally, he noted that when a prop guard equipped engine strikes anything at all, the entire lower unit usually breaks, resulting in a much higher cost than just replacing a propeller.

Chairman Garden asked how their safety record compares with the boating population at large.

Mr. Mitchell replied that they had operated for 18 years without a death, but unfortunately, two weeks ago they had one. A few things in his favor are: (1) Drinking and operating a craft is not permitted and (2) there are 11 patrol boats which are trained to remove an operator who may pose a danger.

The question was asked how many people rent and operate these small livery boats.

Mr. Mitchell replied that 365,000 people per year is a conservative estimate.

Mr. Vinton asked if the users of livery boats are required to wear PFDs.

Mr. Mitchell replied "Absolutely, as a matter of fact the PFDs for motorboats are equipped with a lanyard which is attached to the PFD and connected to the kill-cap which shuts off the engine if a person gets too far out of his seat". The patrol officers also check to make sure that PFDs are buckled.

The question was asked about the water depth of the lakes.

Mr. Mitchell replied that the deepest area is 60 feet and that the average would be about 20 ft.

COL Ellingsen asked about the minimum age for boat rental.

Mr. Mitchell replied that it is 12 years of age. He added that their problems are not really with the 12 to 16 year olds.

At this point the Council and guests were transported to Walt Disney World to witness first hand the actual briefing which is given to renters of motorboats. The rules are simple. No horseplay, and stay at least 50 feet from everything and anything. Failure to abide by the rules results in termination of the operator's boating career at Walt Disney World, a ride back to the dock on a patrol craft and no refund for unused rental time.

The group returned to the Las Palmas Inn at 1810.

Recess

TUESDAY 7 NOVEMBER 1989

0800 Chairman Garden called the meeting to order.

MEMBERS PRESENT

Same as preceeding day (except Ms. Ferrell)

MEMBER ABSENT

Ms. Ferrell

VIDEO – "Boating Safety" courtesy of WCVB-TV/BOSTON

REPORT OF THE COMMITTEE ON PROPELLER GUARDS

Captain James Getz, Subcommittee Chairman, explained that his committee was charged to review, among other things, available information and obtain as much information as possible on the issue of strikes by boat or propeller and subsequent or possible guarding or other related issues. He said that they provided the first objective opportunity for public review of what everyone knows is a very emotional and highly controversial subject. He stressed that the subcommittee was given only a charge and no specific recommendations or suggested conclusions by either the Council Chairman or the Coast Guard. He remarked that the final report received unanimous approval by the subcommittee members and there were no dissenting opinions or views. Captain Getz orally presented the following conclusions of the subcommittee to the Council.

1. Accident data and the analysis of accident data must be an integral component of a study of this nature. There is no one single source, best source, or all-inclusive source of accident data. However, the available sources can be utilized collectively to give an accurate portrayal of the significance, frequency, and relative magnitude of underwater impact to other causes of boating accidents in particular and accidents in general. There is no indication that any change in reporting would reflect significant changes in the relative position or percentage of injuries/fatalities due to underwater impacts. Therefore, propeller

guarding at best could have only a negligible impact on improving boating safety.

2. Injuries/fatalities, caused by underwater impacts, result from a person coming into contact with the propeller or any part of the propulsion unit (i.e., lower unit, skeg, torpedo, anti-ventilation plate, etc.) and even the boat itself. Currently reported accidents make it obvious that all such components are involved in the total picture, and that the propeller itself is the sole factor in only a minority of impacts. The development and use of devices such as "propeller guards" can, therefore, be counterproductive and can create new hazards of equal or greater consequence.

3. Operator error is clearly a significant factor in the vast majority of underwater impacts which result in injuries/fatalities. Mandatory equipment requirements could be expected to have only a negligible impact on this problem. The most rational approach to the problem is to educate boaters, especially operators. They must be made to understand the abilities and limitations of their equipment. They must be aware of and understand the hazards their boat can cause to people in the water. Above all, they must be made to understand the consequences of careless or negligent operation of their watercraft, and how they, as boat operators, can act to prevent accidents.

4. Although the controversy which currently surrounds the issue of propeller guarding is, by its very nature, highly emotional and has attracted a great deal of publicity, there are no indications that there is a generic or universal solution currently available or foreseeable in the future. The boating public must not be misled into

thinking there is a "safe" device which would eliminate or significantly reduce such injuries or fatalities.

Captain Getz informed the Council that his subcommittee's recommendations are:

1. The U.S. Coast Guard should take no regulatory action to require propeller guards.

2. The U.S. Coast Guard should, through improved accident reporting and analysis, develop a complete and comprehensive data base on underwater impact accidents. This should involve, as an integral part, U.S. Coast Guard involvement in the National Electronic Injury Surveillance System (NEISS) and the appropriate training of involved hospital personnel.

3. The U.S. Coast Guard should implement necessary steps to have included in national and state level educational and awareness campaigns the information regarding potential hazards associated with careless or negligent boat operation. Such programs should be on a continuing basis and be as vivid as possible in depicting underwater impact accident scenarios. These programs should state in a positive manner how such accidents can be prevented by diligent, informed boat operators.

4. The U.S. Coast Guard should work with appropriate voluntary standards-making organizations (such as ABYC and SAE) to develop meaningful warning labels, and define their most effective locations, concerning the hazards of underwater impacts.

5. The U.S. Coast Guard should review manufacturing safety standards of watercraft, emphasizing the importance of keeping passengers and operators in the boat,

and maintaining the unobstructed fore and aft vision of the boat operator.

6. The U.S. Coast Guard should encourage a systematic review of current enforcement programs aimed at reducing boat accidents and should provide all possible support to implement, maintain, and expand those programs targeting the prevention of accidents.

Captain Getz publicly thanked subcommittee members Richard H. Lincoln, William D. Selden and Herman T. Van Mell and Coast Guard representative Donald J. Kerlin for their extremely significant contributions to the project.

MOTION: that the Council accept the report, adopt the recommendations of the subcommittee, and discharge the subcommittee as having completed its task.

VOTE: In Favor – Unanimous

Mr. Lincoln commended Captain Getz for his performance as chairman of the subcommittee.

Chairman Garden told the Council that he had attended most of the subcommittee's meetings and had a very favorable impression of Captain Getz's leadership abilities.

Ms. Linda Barnby, a propeller strike accident victim, informed the Council that many more propeller strike accidents have occurred than have been reported to boating authorities. She feels that it is obvious that all related information is not in yet and that the search for new technology must continue in order to protect people and marine life.

A complete copy of the subcommittee's report may be obtained by contacting the Executive Secretary at the address or phone number listed on the first page.

Copies of all documents reviewed by the subcommittee may be obtained by contacting the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

Ms. Judith Vallee, Save the Manatee representative, informed the Council on the problem of injury or death of manatees as a result of contact with boats and/or motors in Florida waters. She concurred with Ms. Barnby's recommendation for continued research on propeller guards.

Chairman Garden assured the Council and guests that this is not a dead issue. If new pertinent information becomes available, a subcommittee will be reconvened.

REPORT ON THE 1990 NATIONAL SAFE BOATING WEEK

Mr. Dick Bogue, chairman of the 1990 NSBW, told the Council that he wants to be sure that every Council member receives a copy of the 1990 National Safe Boating Week action kit, which is comprised of posters and everything else that is required to run a campaign. He likened a boating safety campaign to a political campaign with each area having different priorities and problems. The Action manual will be arranged in such a manner so as to show a person how to organize, deal with the media and be either for or against an issue. A distribution center has been set up to send out between 250,000 to 300,000 kits when they are complete. He also told about contacting

marine catalog publishers about illegible boating safety messages in their publications. All of them agreed to do so if they are furnished camera ready script. He has some people who are putting together a program to give to public libraries so they can promote the cause. He also asked Phil Keeter to look into the possibility of getting food stores to put boating safety messages on the back of cash register receipts. His goal is to get everyone interested in promoting boating safety to be on the same bandwagon and either vote for boating safety or against death and destruction. He concluded by soliciting help and suggestions from everyone.

Mr. Anderson reminded the Council that this project is being billed as the National Safe Boating Campaign, 1990 so that people get the message that this is a 52-week-a-year campaign and that National Safe Boating Week is just to kick it off.

PRESENTATION ON PONTOON BOATS

Mr. Kerlin briefed the Council on the status of pontoon boats. He said that the only Federal Requirement that affects these craft is the Hull Identification Number (HIN) requirement. The regulations dealing with capacity, flotation, horsepower, etc. only apply to mono-hulled boats. However, as the result of comments that former Council member Bolling Douglas made some time ago, the issue was looked into. He informed the Council that the American Boat & Yacht Council (ABYC) has developed voluntary standards H-35, entitled Powering and Loading Capacities of Pontoon Boats. These will be published within the next three months. He said that these

particular standards are intended to prevent these craft from corkscrewing, submarining and capsizing from too many people going up forward on the deck at one time. This voluntary standard also addresses factory supplied accessories and options installed after the original unit is checked for weight carrying capacity as well as the subject of self-draining decks. For stability purposes the rails must be a minimum of 48 inches aft of the tip of the pontoon and the distance between the fore and aft rails is eight-tenths of the overall length.

Chairman Garden asked if the Coast Guard has the authority to create a mandatory standard.

Mr. Kerlin replied "Yes, however the existing regulations would have to be changed because they specifically refer to mono-hulled boats".

Mr. Game told the Council that this is a good example of the government working with the private sector to develop voluntary standards.

Mr. Kerlin said that this voluntary standard will be incorporated into next year's certification program by NMMA.

UPDATE ON 1990 NATIONAL BOATING EDUCATIONAL SEMINAR

Mr. Bob Green, chairman of the upcoming seminar, explained that the sponsor of the event is the National Safe Boating Council, a group of over 70 organizations that are involved in boating safety. The seminar will be held in Orlando, Florida from March 3rd to the 7th, 1990 at the Holiday Inn on International Drive. He reported that the organization would be meeting later in the day to

finalize the agenda. He said that the seminar is open to anyone who is involved in boating safety. These will be several exciting on-the-water demonstrations, a presentation on the U.S. Power Squadrons video boating course and numerous highly qualified speakers.

BREAK

PRESENTATION ON LIGHTHOUSE AUTOMATION

LT John Brooks, Aids to Navigation Branch, Coast Guard Headquarters, told the Council that this is the 200th anniversary of lighthouse service as a Federal government function. The first Federally constructed lighthouse was old Cape Henry Light which was used to mark the entrance to the Chesapeake Bay. It is now a historic landmark. He said that there are 450 active U. S. Coast Guard-maintained lighthouses around the country and all except four are automated. Automation has occurred for three primary reasons. They are: (1) efficiency, (2) economy and (3) the invention of the fog detector. The Lighthouse Automation and Modernization Program (LAMP), a 20-year program initiated in 1968 and extended 1 year, will officially wind up this year. As of next summer, Boston Light will be the only manned light remaining in the country. Explaining the various categories of lights, LT Brooks said that Category 1 lights are AC powered, either by direct shore power connections or a generator. They also have monitors, remote control capability and a DC power backup. He said that the less important Category 3 lights do not usually have automatic power system back-up or remote control capability. He told the Council that some lights are solar powered. He added that $27

million was authorized for the LAMP program 21 years ago. Ten years into the program the costs became negative and now it is estimated that it saves the government about $7 million per year. He concluded by telling the Council that President Bush had proclaimed August 7, 1989 as National Lighthouse Day to commemorate the bicentennial of the service and that the Postal Service will issue a series of five special lighthouse stamps next year.

Chairman Garden stated that there seems to be community oriented opposition to the automation of lighthouses. He asked what is being done to avert this feeling.

LT Brooks replied that the various communities must be informed that it is not economically feasible to man all lighthouses. He also said that the media must be educated to the fact that just because a lighthouse is no longer manned it is not an indication that it is no longer needed.

Chairman Garden relayed to the Council that back in the early 50's he was on the staff of the Coast Guard District Commander in New York when Headquarters ordered a reduction in expenses for Aids to Navigation. On the list for possible reduction was the disposal of Jeffery's Hook Light on the Hudson River beneath the George Washington Bridge. An unsuccessful attempt had been made to donate the light to the New York City Department of Parks. Bids were then requested to dismantle the light by private concerns. The single bidder requested $20,000 to tear down the light which was not acceptable. Mr. Garden relayed how his energetic Chief Journalist did research at the public library and found a children's storybook entitled *The Little Red Lighthouse and the Great Grey Bridge*.

This book was used to publicize their predicament in *Life* and *Time* magazines and several local publications. As a result of the publicity, the City of New York's Parks Department accepted responsibility for the ownership and upkeep of the structure. Incidentally, the Chief Journalist's name was Alex Haley.

"PASSENGERS FOR CONSIDERATION" SUBCOMMITTEE RECOMMENDATIONS UPDATE

LT Randell Sharpe, Merchant Vessel Inspection Division (G-MVI), Office of Marine Safety, Security and Environmental Protection, Coast Guard Headquarters, informed the Council that various elements of his Office had reviewed the subcommittee's recommendations and in turn have advised against going forth with them at this time. He said that the definition of "Passenger" must remain unchanged so as to allow the Coast Guard to enforce, in a broad nature, the safety regulations for passenger carrying vessels. He remarked that there are five different definitions of "Passenger" in the law and that none of them match. He reported that his office is attempting to produce a legislative proposal that would result in changing the law so that there will be only one uniform definition of "Passenger". He told the Council that once some progress is made on this proposal, comments will be welcome even though it is not a proposed rulemaking.

Mr. Van Mell, Subcommittee Chairman, said that his committee realized that this is a complex problem and should have legislation enacted to correct it. He added that

sooner or later some insurance company will void a recreational boater's policy because he was technically carrying passengers for consideration. He also requested that any legislative proposal should be reviewed by the Council.

Mr. Simon informed the Council that the real problem is insurance coverage.

Mr. Game recommended that the subcommittee be reactivated.

Chairman Garden suggested that as progress is made on this there should be participation by the Council.

LT Sharpe replied that he sees no problem with that as long as the Council, charter boat organizations, and the party vessel owners can agree on a middle ground.

Mr. Donheffner asked if there is a draft definition.

LT Sharpe replied "Not at the present time".

SUBJECTS OF GENERAL INTEREST

CAPT Griswold briefed the Council on the following activities of various Divisions in the Office of Navigation.

NATIONAL SEARCH AND RESCUE SCHOOL

The Executive Director informed the Council that this school had recently been moved from Governor's Island, New York to Yorktown, Virginia.

COMPUTER CENTER

CAPT Griswold told the Council that plans are being made to move the Coast Guard's computer center to a new location in Martinsburg, West Virginia.

RADIONAVIGATION PROGRAM

CAPT Griswold gave a brief update on the Radionavigation Program. He said that the LORAN system will soon be in service completely across the country. A LORAN chain is being developed in the Aleutian Islands through a cooperative agreement with the Soviet Union. He also spoke about the OMEGA System and the Global Positioning System (GPS). He expects GPS equipment to become affordable for recreational boaters in the near future. The Captain mentioned that the Coast Guard is working on turning over several LORAN stations to their host countries

Mr. Brightbill asked about the timetable for completion of the mid-continent LORAN.

CAPT Griswold replied that it should be in the near future.

The Captain told the Council that the 406 MHz Emergency Position Indicator Radio Beacons (EPIRBs) are coming into being on schedule. This new unit is a big improvement over the earlier models.

Captain Griswold concluded by informing the Council on the Coast Guard's replacement program for the 44 ft. motor lifeboat.

Mr. Game asked about the statistics quoted on the earlier boating safety news film.

Chairman Garden replied that it was a local TV program from Boston and they were quoting Massachusetts statistics which are running ahead of average this year.

Mr. Game remarked that high-visibility PFDs should be required to be worn by all persons engaged in high-risk water activities like water skiing or personal watercraft use.

Chairman Garden reported that Mr. Bogue will mail a copy of the new UL PFD standards to each Council member.

RESPONSE TO MEMBERS' ITEMS

THRILLCRAFT EXEMPTIONS

In response to Chairman Garden's concern about the new outboard powered version of thrillcraft and the exemptions that have been issued to previous models, Mr. Kerlin told the Council that thrillcraft can not be rated for weight carrying or horsepower capacity because of their unusual design. He said that he takes exception to the industry's definition of a personal watercraft as being jet powered and less than 16 feet in length. The bottom line is that they are regulated by the Coast Guard. He added that there are no available statistics to prove additional danger of prop strike on personal watercraft/thrillcraft (PWC/TC). There are 43 manufacturers of this type craft on file. In response to the concern about how many units are in use, Mr. Kerlin replied that he does not have a reliable estimate.

CHANGING HIN's

Mr. Kerlin, responded to Mr. Brightbill's concern about manufacturers changing the left over boat's HIN in order to sell the unit as a new, current year item, by saying that basically after a boat hull leaves the place of manufacture, the manufacturer must first get Coast Guard authorization before a HIN may be legally changed. The changing of the model year on a boat is a manufacturing and moral concern.

Mr. Ladd informed the Council that many States will confiscate a boat that has an altered HIN.

COL Ellingsen informed the Council that it sounds like consumer fraud when a model year is updated.

Mr. Game added that he feels that the practice should be stopped.

Mr. Kerlin repeated that as long as a boat remains at its place of manufacture the builder can do anything that he feels like doing. Coast Guard permission is necessary to alter a HIN after the boat leaves the factory. He added that to date only two petitions for change of HINs have been received by the Coast Guard.

Mr. Brightbill said he was shocked by the number of boats he saw at the Chicago Trade Show that had obviously altered HINs. He asked what the penalty is for failure to get permission to alter a HIN.

Mr. Kerlin replied, "$1,000.00 per boat".

Chairman Garden told the Council that two new subcommittees will be formed and one of them will be addressing this issue in depth.

EXPAND H.P. REGULATIONS TO BOATS OVER 20 FEET IN LENGTH

Mr. Kerlin responded to Colonel Ellingsen's desire to have the horsepower regulations expanded so as to include boats that are 20 ft. or more in length by telling the Council that at present the Coast guard has no data or statistics available to justify expansion of these regulations. If justification becomes available, a change will be considered.

STATE FUNDING GRANTS

In response to Captain Getz's concerns that the States will not receive their full share of funding, Captain Griswold informed the Council that Mr. George Stewart and Mr. Tom Atkinson, the president of NASBLA had met with the Vice Commandant and Commandant and were assured that they have the Coast Guard's support on this.

RAIDS ON TRUST FUNDS

Responding to Mr. Haseltine's concern about a possible raid on boating trust funds, Captain Griswold said that he is not aware on [sic] any impending raid but he will keep on the alert.

COMPREHENSIVE PLAN FOR BOATING EDUCATION

Captain Griswold told the Council that his first priority is to try to hire two additional people to work for Mr. Hunt Anderson. Chief Education Branch. The Captain said that when additional help is received a long-range plan will be developed. At present Mr. Anderson is developing a

plan that can be used by various organizations to create a specific function-oriented education program.

Mr. Lincoln remarked that he was greatly encouraged by Mr. Anderson's presentation the preceding day. He also urged Mr. Anderson to contact Mr. Bill Eck, Chairman, NMMA's Permanent Committee on Education, for assistance as well as to exchange information.

SUBCOMMITTEE FUNDING

Captain Griswold explained that the Department of Transportation has a ceiling on what is allowed to be spent by advisory committees. He said that two new Coast Guard advisory committees were established this past year without additional funding and that put additional constraints on existing committees. The Executive Director pledged ongoing support to the Council and its subcommittees.

NAME CHANGE FOR RORAC

CDR Meyers, responding to Mr. MacNeills's concerns, briefed the Council on the history of RORAC and said that the name change and expansion of responsibilities will probably take place in the near future when the Coast Guard's Authorization Bill is enacted. The new responsibilities will include Inland & International Rules of the Road, navigation regulations and equipment, Aids to Navigation systems, routing measures, marine information and diving safety. The new Council will be named the Navigation Safety Advisory Council and will be required to meet at least two times per calendar year.

STANDARDIZED PUMP OUT CONNECTIONS

Mr. Bergen responded to Mr. Simon's concern, that pump out facilities use various size connections for pumping a boat's holding tank, by informing the Council that the Coast Guard does not have the regulatory authority to deal with pump-out fittings or holding tanks or the shore pump-out station's connections. However the ABYC has some voluntary standards on holding tanks which have a blank page where the standard connection size should be.

Mr. Simon replied that he wants to get the blank page filled in to create a universally standard size for connections.

STANDARDIZED COLOR & SIZE FOR SPEED ZONE BUOYS

Captain Griswold replied to Mr. Simon's desire to have a standard size and color for speed zone buoys by saying that color and design for control buoys is already addressed by the Uniform State Waterways Marking System.

INCREASED BOATER EDUCATION ON HURRICANES

Captain Griswold responded to Mr. Tulla's suggestion to increase boater education concerning hurricane survival by telling the Council that several publications, such as Chapman's, have sections explaining how a boater can protect himself against hurricanes. There are also several pamphlets on the subject that could use wider distribution in preparation of the storm season.

MARPOL REGULATIONS

Mr. Bergen replied to Mr. Game's concern about the intent of the new garbage regulations by stating that a new Boating Safety Circular, which explains the proposed regulations, will be distributed to over 15,000 recipients in the near future.

EDUCATION SUBCOMMITTEE REPORT UPDATE

Captain Griswold responded to Mr. van Orman's concern about action taken as a result of the subcommittee's final report by telling the Council that some restraints have prevented rapid expansion of the education program. However, a good number of the financial grants for non-profit organizations were education oriented. He intends to monitor the State programs that have mandatory education and at some future time compare them with the programs of States that have no such requirement.

Mr. Selden told the Council that he feels the Coast Guard's main thrust should be to promote existing volunteer organizations that teach and encourage safe boating. This can be accomplished by mentioning these organizations in TV spots and other promotions.

Captain Griswold responded that all organizations are actively promoted as well as the 800 Boating Course telephone number (1-800-336-BOAT. In VA 800-245-BOAT).

HALON FIRE EXTINGUISHERS

Mr. Sciulla remarked that he understands that a bill has been submitted to prohibit Halon Fire Extinguishers.

Captain Griswold replied that he is aware of a Federal group that is looking for an alternative to Halon by 1991.

COAST GUARD PUBLIC SERVICE COMMENDATIONS

Captain Griswold and Chairman Garden presented the Coast Guard Public Service Commendation to Messers Bishop, Blackistone, Lincoln, Van Mell and van Orman, Captain Getz and Mrs. Toups.

Mr. Bishop remarked that he thoroughly enjoyed his membership on the Council which is comprised of a dedicated group of professionals.

Mr. Blackistone echoed Mr. Bishop's comments and said he hopes that we continue as a universal group to solve the problems that are out there.

Captain Getz said that he was honored to be one of seven State representatives serving on the Council. Additionally he felt very honored to serve with all of the other members and especially Chairman Garden, who responded that the "Class of 89" will be missed.

Mr. Lincoln remarked that the Council is a fantastic organization and he feels the Congress is lucky that the Council is working out so well. He also said that the Coast Guard is extremely fortunate to have the quality of people selected for membership on the Council

Mrs. Toups said that she felt very comfortable working with the people on the Council and thought that the three-segment makeup of the Council was an excellent idea.

Mr. Van Mell related that service on the Council has been a very enjoyable and rewarding experience and was grateful for the opportunity to serve.

Mr. van Orman remarked that public service carries its own special brand of reward and it's certainly not monetary. His service has been enjoyable and educational. He was thoroughly impressed with the capable leadership provided by the chairman.

CHAIRMAN'S SESSION

Chairman Garden informed the Council that he was directed at the last meeting to contact the Chairman of NASBLA and advise him of the recommendation that it was not appropriate or within the Coast Guard's responsibility to suggest that liability insurance be required for personal watercraft operators because it is clearly not a Federal issue but something that the States might choose to look at. He did write to Mr. Tom Atkinson, NASBLA President.

Chairman Garden reported that he had received a nice note from Barbara Lippmann in response to his letter of condolence after Jim's death.

Chairman Garden, on a brighter note, congratulated Mr. Lysle Gray on his appointment to the position of Executive Director of ABYC.

NEW SUBCOMMITTEES

Chairman Garden appointed members to serve on two new committees. They are:

The Coast Guard Consumer Relations Review Subcommittee consisting of Mr. Simon as chairman, Messrs. van Orman, Donheffner, Vinton, Game, and MacNeill as members and Mr. Bergen as the Coast Guard representative.

The Recreational Boating Standards Review Subcommittee consisting of Mr. Haseltine as chairman, Ms. Ferrell and Messrs. Van Mell, Scott, Brightbill, and Montgomery as members and Mr. Kerlin as the Coast Guard representative.

Specific charters and charges will be drawn up for each subcommittee in the near future.

Chairman Garden announced that the National Safe Boating Council will meet beginning at 2:00 pm in the same room. He mentioned that Jim Ellis will be the incoming chairman of that organization.

Chairman Garden thanked Wayne Mitchell for his very educational part in the program and his hospitality at Walt Disney World. Additionally, he thanked Admiral Nelson and Captain Griswold for their hospitality at the wine and cheese reception the previous evening. He closed by reminding everyone that the next meeting will be in May, 1990 in Denver, Colorado.

Meeting adjourned at 1216.

This is to certify that the above are the accurate minutes of the forty-fourth meeting of the National Boating Safety Advisory Council.

/s/ A. Newell Garden

A. Newell Garden, Chairman
National Boating Safety
Advisory Council

Enclosures: (1) Summary of State BAC Laws
(2) List of guests

SUMMARY OF STATE "OUI" BOATING LAWS

September 1989

	BLOOD ALCOHOL CONCENTRATION STANDARD	BEHAVIORAL STANDARD	FIELD TEST METHODS DEFINED	IMPLIED CONSENT LAW	MAXIMUM PENALTIES FIRST OFFENSE	SUSPEND OPERATOR PRIVILEGE
ALABAMA	–	NO	NO	NO	$ 500/6 MOS.	YES
ALASKA	.10	NO	NO	NO	$ 500/6 MOS.	NO
ARIZONA	.10	NO	YES	YES	$1000/6 MOS.	NO
ARKANSAS	–	YES	NO	NO	$ 500/6 MOS.	NO
CALIFORNIA	.10	NO	YES	NO	$1000/6 MOS.	NO
COLORADO	.10	YES	YES	YES	$1000/6 MOS.	YES
CONNECTICUT	.10	NO	NO	NO	$1000/1 YR.	YES
DELAWARE	–	NO	NO	NO	$ 500/10 DAYS	YES
FLORIDA	.10	YES	YES	YES	$ 500/6 MOS.	YES
GEORGIA	.10/.12	YES	YES	YES	$1000/1 YR.	NO
HAWAII	–	NO	NO	NO	$1000/1 YR.	YES
IDAHO	.10	NO	NO	NO	$ 300/30 DAYS	YES
ILLINOIS	.10	YES	YES	YES	$1000/1 YR.	YES
INDIANA	.10	YES	YES	YES	$ 500/6 MOS.	YES
IOWA	–	YES	YES	NO	$1000/1 YR.	NO
KANSAS	.10	NO	YES	NO	$ 500/1 YR.	NO
KENTUCKY	–	NO	NO	NO	$ 100	NO
LOUISIANA	.10	NO	YES	YES	$ 500/6 MOS.	YES
MAINE	.08	YES	YES	YES	$ 500/6 MOS.	NO
MARYLAND	.07/.10	NO	YES	NO	$ 500	NO
MASSACHUSETTS	–	NO	NO	NO	$ 500/6 MOS.	NO
MICHIGAN	.10	YES	NO	NO	$ 500/90 DAYS	YES
MINNESOTA	.10	YES	YES	YES	$ 700/90 DAYS	YES
MISSISSIPPI	–	NO	NO	NO	$ 250/30 DAYS	NO
MISSOURI	–	NO	NO	NO	$ 500/6 MOS.	NO
MONTANA	.10	NO	YES	YES	$ 500/6 MOS.	NO
NEBRASKA	.10	NO	YES	YES	$1000/6 MOS.	NO
NEVADA	.10	NO	YES	YES	$1000/6 MOS.	NO
NEW HAMPSHIRE	.10	NO	YES	YES	$1000/1 YR.	YES
NEW JERSEY	.10	NO	NO	YES	$1000/6 MOS.	YES
NEW MEXICO	–	NO	NO	NO	$ 500/30 DAYS	NO

NEW YORK	.10	NO	YES	NO	$ 350	NO
NORTH CAROLINA	.10	NO	NO	NO	$ 500/6 MOS.	NO
NORTH DAKOTA	–	NO	NO	NO	$ 500/30 DAYS	NO
OHIO	.10	YES	YES	YES	$1000/1 YR.	YES
OKLAHOMA	–	NO	NO	NO	$1000/6 MOS.	NO
OREGON	–	YES	NO	NO	$2500/1 YR.	NO
PENNSYLVANIA	.10	NO	YES	YES	$2500/90 DAYS	YES
RHODE ISLAND	–	NO	NO	NO	$ 500/6 MOS.	NO
SOUTH CAROLINA	–	NO	NO	NO	$ 200/30 DAYS	YES
SOUTH DAKOTA	–	NO	NO	NO	$1000/1 YR.	NO
TENNESSEE	.10	NO	NO	YES	$1000/12 MOS.	YES
TEXAS	.10	YES	NO	YES	$1000/6 MOS.	NO
UTAH	.08	NO	YES	YES	$1000/6 MOS.	YES
VERMONT	.10	YES	NO	NO	$ 300/3 MOS.	YES
VIRGINIA	.10	NO	NO	YES	$1000/1 YR.	YES
WASHINGTON	.10	NO	NO	NO	$1000/90 DAYS	NO
WEST VIRGINIA	–	NO	NO	NO	$ 300/90 DAYS	NO
WISCONSIN	.10	NO	YES	YES	$200	NO
WYOMING	.10	NO	NO	NO	$ 750/6 MOS.	YES
AMERICAN SAMOA	–	NO	NO	NO	$1000/1 YR.	YES
DC	–	NO	NO	NO	$ 300/10 DAYS	NO
CNMI	–	NO	NO	NO	$1000/1 YR.	YES
GUAM	–	NO	NO	NO	$1000/1 YR.	YES
PUERTO RICO	.10	NO	NO	NO	$ 500/2 MOS.	NO
VIRGIN ISLANDS	.10	NO	YES	YES	$1000/1 YR.	NO

NOTES:

1. Unlawful in all States to operate a vessel under the influence (OUI) of alcohol or drugs.
2. *Blood Alcohol Concentration (BAC).* Where the column shows two figures, this indicates the State has established progressively stiffer penalties for different levels of intoxication.
3. *Implied Consent Law* means the refusal of a boater to submit to a test for intoxication (e.g. breathalyzer, blood test, etc.) may be introduced in court as evidence of intoxication, and in some States, it may be considered as a separate offense.
4. *Field Test Methods Defined* means that the general method of determining blood alcohol concentration, or other standard of intoxication illegible the law or regulation.

Guests at 44th NBSAC meeting

Name	Association	address	phone no.
Jay E. Brown	National Boating Federation	3217 Fiji Lane Alameda, CA 94501	415-523-2098
Mike Sciulla	BOAT/US	880 S. Pickett St. Alexandria, VA 22304	703-828-9550
Jim Ellis	BOAT/US	880 S. Pickett St. Alexandria, VA 22304	703-823-9550
Mary M. Mann	NMMA	1000 Thomas Jefferson St. Washington, DC 20007	202-338-6662
Phil Keeter	MRAA	155 N. Michigan Ave. Chicago, IL 60601	312-938-0359
Aime Bernard	USCGAUX	400-SC Orlando Ave. Ocoee, FL 34761	407-656-9828
Bob Malone	National Safe Boating Council	1679 A S. Hay St. Arlington, VA 22202	703-521-2997
Ron Stone	NMMA	Washington, DC	202-338-6662
Bill Ladd	Outdoor Empire	511 Eastlake Ave. Seattle, WA 98109	206-624-3845
Gilles R. Gareau	CDN Coast Guard	Canada Bldg (AMSFC) 344 Slater St. Ottawa ONT KIAON7	613-991-3129
John Dane	NMMA	1000 Thomas Jefferson St. Wash., DC 20007	202-338-6662
Lysle B. Gray	ABYC	Box 747 Millersville, MD 21108	301-744-4850
Dick Bogue	U.L.	12 Laboratory Drive Research Triangle Park, NC 27709	919-549-1565
John Hannon	USCG (G-MVI)	Washington, DC.	202-267-1464

Robert Green	USPS NSBC	59 Webb Ave. Ocean Grove, NJ 07756	201-776-6020
David Gaul	USCG	25 Walkers Ridge Dr. Ponte Vedre Bch., FL 32032	904-285-9849
Greg Schafer	USCG (MSO)	155 Columbia Pr. Tampa, FL	813-709-2736
Susan Blake	American Red Cross	17th & D St, NW Wash., DC 20006	202-639-3106
Chris Jackson	WESH-TV	Winter Park, FL	407-645-2222
Sandra Custer	Guest	Jensen Beach, FL	407-334-8982
Judith Vallee	Save the Manatee	Orlando, FL	407-539-0990
Linda Barnby	Guest	Winter Park, FL	407-647-7871
Dennis Carroll	NOAA	Rockville, MD	301-443-8157
Margot J. Brown	NBF	3217 Fiji Lane Alameda, CA 94501	415-425-2098

CERTIFICATE OF TRUE COPY

I HEREBY CERTIFY that the attached (~~is a true copy~~)
(are true copies)
of the original Minutes of the 44th Meeting of the National Boating Safety Advisory Council; Report of the Propeller Guard Subcommittee of the National Boating Safety Advisory Council; and Rear Admiral Robert T. Nelson letter to Mr. A. Newell Garden of February 1, 1990.

on file in the Auxiliary, Boating, And Consumer Affairs Division

Signed and dated at Washington, DC

this 2nd day of April , 1992

/s/ Albert J. Marmo

By Albert J. Marmo

Assistant Chief, Auxiliary, Boating,
And Consumer Affairs Division
(Title)

I HEREBY CERTIFY that Albert J. Marmo

who signed the foregoing certificate is now, and was, at the time of signing Assistant Chief, Auxiliary, Boating, And Consumer Affairs Division.

and that full faith and credit should be given his certificate as such.

[SEAL]

IN WITNESS WHEREOF I have hereunto subscribed my name and caused the seal of the Department of Transportation to be affixed this 2ND day of APRIL , 1992

at WASHINGTON, D.C.

/s/ William B. Thomas

WILLIAM B. THOMAS
(Signature)

CHIEF, CLAIMS AND LITIGATION DIVISION UNITED STATES COAST GUARD HEADQUARTERS
(Title)

WASHINGTON, D.C. 20593-0001
Department of Transportation

EXHIBIT 7

Mr. A. Newell Garden
Chairman, National Boating
Safety Advisory Council
20 Hunter Street
West Newton, MA 02165

Dear Mr. Chairman:

We have completed our review of the "Report of the Propeller Guard Subcommittee" which was approved by NBSAC on 7 November 1989. All of the report's recommendations are accepted. The recommendations will be implemented within resource limitations as outlined below:

NBSAC Recommendation 1. The U. S. Coast Guard should take no regulatory action to require propeller guards.

Coast Guard Position. The regulatory process is very structured and stringent regarding justification. Available propeller guard accident data do not support imposition of a regulation requiring propeller guards on motorboats. Regulatory action is also limited by the many questions about whether a universally acceptable propeller guard is available or technically feasible in all modes of boat operation. Additionally, the question of retrofitting millions of boats would certainly be a major economic consideration.

The Coast Guard will continue to collect and analyze accident data for changes and trends; and will promote increased/improved accident reporting as addressed in recommendation 2. The Coast Guard will also review and retain any information made available regarding development and testing of new propeller guarding devices or other information on the state of the art.

NBSAC Recommendation 2. The U.S. Coast Guard should, through improved accident reporting and analysis, develop a complete and comprehensive data base on underwater impact accidents. This should involve, as an integral part, U.S. Coast Guard involvement in the National Electronic Injury Surveillance System (NEISS) and the appropriate training of involved hospital personnel.

Coast Guard Position. There are several avenues to obtaining better accident data. The key is accident investigation. The Coast Guard has been promoting and assisting increased and improved state boating accident investigation for a number of years. Several Coast Guard initiatives have been applied including development of a comprehensive "Marine Accident Investigation Manual," an annual series of Boating Accident Investigation Seminars around the country, and installation of an accident investigation module at the Coast Guard's National Boating Safety Course for state personnel. The need for a closer look at boat and propeller strike accidents will be stressed in the training.

We intend to go beyond existing Coast Guard/state accident reporting channels. We have explored Coast Guard participation in the National Electronic Injury Surveillance Systems in the past and will take a renewed look at participation. Additionally, we are seeking proposals to improve accident reporting and analysis through our National Nonprofit Public Service Organization Grant Program. We are, for example, considering the use of college students to gather hospital emergency room and clinic information on boating accidents.

NBSAC Recommendation 3. The U.S. Coast Guard should implement necessary steps to have included in national and state level educational and awareness campaigns the information regarding potential hazards associated with careless or negligent boat operation. Such programs should be on a continuing basis and be as vivid as possible in depicting underwater impact accident scenarios. These programs should state in a positive manner how such accidents can be prevented by diligent, informed boat operators.

Coast Guard Position. National educational campaigns have been aimed at the major causes and types of boating accidents and means of preventing and mitigating, e.g., need for education and PFD wear, drinking and boating problems, capsizing and falls overboard from small boats. More specific campaigns focused on hypothermia, problems associated with boat use for fishing and hunting, etc. While struck by boat and/or propeller accidents aren't among the major types of boating accidents, careless and negligent operation are major causes of boating accidents. Results and means of avoiding underwater impact accidents could effectively be interwoven into campaigns aimed at negligent operation. The Coast Guard will explore means and opportunities for doing and promoting this. A series of articles in our Boating Safety Circular will be developed aimed at avoiding boat/propeller strike accidents. Topics could include, for example, hazards, available propeller guards, warning labels, keeping people in the boat, avoiding bow and rail riding, avoiding swimming areas, etc.

NBSAC Recommendation 4. The U.S. Coast Guard should work with appropriate voluntary standards making organizations (such as ABYC and SAE) to develop meaningful warning labels, and define their most effective locations, concerning the hazards of underwater impacts.

Coast Guard Position. The Coast Guard is soliciting for project proposals to do this through our National Non-profit Public Service Organization Grant Program. If this mechanism is unsuccessful, we will approach ABYC and SAE regarding including warning label development in their respective work programs.

NBSAC Recommendation 5. The U.S. Coast Guard should review manufacturing safety standards of watercraft, emphasizing the importance of keeping passengers and operators in the boat, and maintaining the unobstructed fore and aft view of the boat operator.

Coast Guard Position: Improvements may be difficult to address through the regulatory process because of the need for quantitative justification and the vast array of boat configurations. The Coast Guard will make industry more aware of the considerations of adequate operator visibility and designs to facilitate keeping persons in the boat. Voluntary standards and design guidelines may be the only alternative to address this recommendation in a structured fashion.

NBSAC Recommendation 6. The U. S. Coast Guard should encourage a systematic review of current enforcement programs aimed at reducing boat accidents, and should provide all possible support to implement, maintain and expand those programs targeting the prevention of accidents.

Coast Guard Position. Enforcement is a major component of a boating safety program. Initially, the Coast Guard will address this recommendation through guidance to and feedback from the states associated with the allocation and use of state financial assistance, also, the Coast Guard's National Boating Safety Course for state personnel. We will ask NASBLA to task its Law Enforcement/ Uniform Boating Laws Committee with a review of enforcement programs.

Mr. Chairman, NBSAC members have handled this difficult and controversial task in an even-handed and professional manner. I want to commend you for your continuing leadership of the Council and the members of the propeller guard subcommittee for their fine work. Please pass my thanks to all the Council members for their work on behalf of safe boating.

Sincerely,

/s/ Robert T. Nelson
ROBERT T. NELSON
Rear Admiral, U. S. Coast Guard
Chief, Office of Navigation Safety and Waterway Services

EXHIBIT 8

**Motorboat
Propeller
Injuries**

Jon S. Vernick and Associates

**The Johns Hopkins University
Injury Prevention Center**

**Institute for
Injury Reduction**

(SEAL)

**Motorboat
Propeller
Injuries**

Jon S. Vernick and Associates

**The Johns Hopkins University
Injury Prevention Center
and the
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Executive Summary

The purpose of this report is to collect and summarize existing studies of the incidence and severity of motorboat propeller injuries, of the feasibility of propeller injury countermeasures, and of the effectiveness of

manufacturer, regulatory and litigation efforts to reduce these injuries.

Injuries caused by motorboat propellers have been documented in medical literature worldwide for more than 20 years. These injuries are often characterized by massive trauma, including significant blood loss, amputation or death.

In the United States, the Coast Guard has jurisdiction over recreational boating, including the authority to promulgate rules for marine safety equipment and the responsibility for gathering and reporting data on recreational boating injuries. Between 1976 and 1990, the Coast Guard officially reported 175 fatalities and 1,438 non-fatal injuries in its *Boating Statistics* category "struck by boat or propeller," or an average of approximately 100 per year. For a number of reasons, primarily the non-reporting of many propeller injuries to the Coast Guard, these data represent substantial and systematic underreporting. Other estimates of the annual incidence of non-fatal propeller injuries have been much higher: 2,013 in a 1991 Red Cross boating survey and 3,420 in an unpublished 1979 Coast Guard study.

Since most recreational power boats remain propeller-driven, efforts to prevent propeller injuries have concentrated on the design and manufacture of propeller guards – devices in the shape of rings or cages which surround the propeller and separate its spinning blades from people in the water. Propeller guards designed to protect people and marine mammals have been developed and patented by private entrepreneurs for more than 35 years.

No major marine engine manufacturer currently offers for sale any propeller guard intended to protect people in the water. Possible reasons for this position are explored.

Primarily in the context of litigation on behalf of people injured by unguarded boat propellers, a number of analyses of the hydrodynamic feasibility and protective effect of various propeller guards have been conducted. Although there is little consensus as to the hydrodynamic feasibility of guards, several engineering studies suggest that a cage-type guard would prevent most serious limb injuries at speeds at least up to about 10-12 mph. Additional well-designed and unbiased research is needed.

In 1988, a subcommittee of the Coast Guard's National Boating Safety Advisory Council was appointed to examine the issue of propeller injuries and to recommend appropriate regulatory action concerning propeller guards. Relying in part upon the Coast Guard's incomplete data set, in 1989 the subcommittee recommended that no regulatory action be taken to require propeller guards. The Coast Guard accepted the subcommittee's recommendation and no regulations were promulgated.

Given the Coast Guard's refusal to mandate guards and the manufacturers' unwillingness to introduce them voluntarily, the primary remaining propeller injury forum has become tort litigation. A series of cases is discussed, reviewing arguments for and against manufacturer liability, including the legal reasoning and potential societal effect of preempting plaintiffs' case.

Finally, misconceptions about propeller injuries and their prevention are critically examined. Recommendations are made to improve propeller injury data collection

and to encourage the development of feasible countermeasures to reduce the toll of these devastating injuries.

Contents

[Counsels' note: bracketed references are to Joint Appendix pages]

Part One

CLINICAL ASPECTS AND EPIDEMIOLOGY OF PROPELLER INJURIES ..... 1 [174]

Introduction ..... 1 [174]

Clinical Aspects ..... 2 [178]

Epidemiology ..... 3 [180]

Underreporting ..... 8 [190]

Conclusion ..... 12 [199]

Part Two

PREVENTING PROPELLER INJURIES: FEASIBILITY OF COUNTERMEASURES ..... 13 [199]

Introduction ..... 13 [199]

Automatic Protection ..... 13 [201]

Eliminating Propellers: Water Jet Propulsion ..... 14 [202]

Separating Propeller Blades From People: Propeller Guards ..... 15 [204]

Propeller Guard Patents and Private Entrepreneurs ..... 15 [205]

Hydrodynamic Tests and Analyses of Propeller Guards ..... 17 [209]

Robert Taggart Report ..... 17 [209]

Outboard Marine Corporation Tests ..... 18 [211]

Mercury Marine Tests ..... 19 [213]

Chadwell Propeller Guard Tests ..... 20 [215]

Propeller Guard Protective Effect Testing ..... 21 [218]

Richard Snyder "Sausage Tests" ..... 21 [219]

Lawrence Thibault Head Impact Tests ..... 22 [220]

Ben Hogan Diver Tests ..... 22 [221]

University of Tennessee Cadaver Tests ..... 23 [222]

Conclusion ..... 24 [224]

Part Three

PROPELLER INJURY POLICIES, LEGISLATION AND LITIGATION ..... 25 [225]

Introduction ..... 25 [225]

United States Coast Guard ..... 25 [226]

Manufacturers ..... 30 [236]

Litigation ..... 31 [239]

Fitzpatrick v. OMC ..... 31 [240]

Elliott v. Mercury Marine ..... 32 [241]

Preemption Cases ..... 35 [247]

State Action ..... 38 [254]

Conclusion ..... 39 [257]

Part Four

PROPELLER INJURY MISCONCEPTIONS ..... 41 [258]

Part Five

RECOMMENDATIONS ..... 45 [263]

PART ONE

Clinical Aspects and Epidemiology of Propeller Injuries

Introduction

On September 4, 1989, Linda Katherine Hall[1], six months pregnant, was riding in a 16-foot fishing boat on Lake Tohopekaliga in Florida, when her sun visor blew off. While trying to retrieve it, she fell overboard and under the boat. The boat's propeller struck her in the head and sheared off a piece of her skull four inches in diameter. Her baby, delivered by Caesarean section at one pound ten ounces, survived 16 hours. Six days later, Ms. Hall died, one of a growing number of victims of motorboat propeller injuries. [Lebowitz, 1989]

Boating-related injuries occur to operators, passengers, and others in the water, most often in the course of recreation – skiing, boating or swimming – during the crowded summer boating season. [Red Cross, 1991; USCG *Boating Statistics*, 1990]. In recent years, as the result of more than a dozen lawsuits, attention has been focused on motorboat propellers as instruments of devastation that are injuring and killing large numbers of people. [Hogan, 1989; Bolden, 1987]

The motorboat propeller can be deadly. Spinning three to five times faster than the forward speed of the boat [Reed, 1987], its blades are hidden under water, invisible to most victims. Among those struck in the head, few survive. When struck in the extremities, victims often face amputations and severe disfigurement.

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[1] Not her real name.

[Thibault, 1987; Gomez, 1991] These injuries have been described as "devastating," "catastrophic," and "the civilian equivalent of severe battlefield injuries." [Banta, 1979; Mann, 1976, Romano, 1962] Like the hazard which causes them, however, propeller injuries are a hidden category of recreational injuries.

For at least two decades, propeller injuries have been documented in the medical literature as a dramatic but largely preventable class of injury. [Jackson, 1965; Paterson, 1971; Sleight, 1974] Monitoring the true number of propeller injuries, however, has been difficult, since they are substantially and systematically underreported in data published by the United States Coast Guard, the federal agency responsible for boating safety in the United States. In fact, many who have fallen overboard, like Linda Katherine Hall have been included only in the Coast Guard's "fall overboard" category, even though their deaths or injuries were a direct result of a blow from the propeller.

The Coast Guard has a difficult task in policing the nation's crowded recreational waterways with admittedly limited resources. Failure to report known boating injuries in a manner that would illuminate rather than obscure the role of motorboat propellers, however, results in little if any cost or manpower savings. More importantly, the Coast Guard's current data collection and reporting methods preclude sound government decision-making toward the prevention of propeller injuries.

In addition, marine propulsion manufacturers, whose products cause these injuries, have failed to step into the void created by inadequate Coast Guard data. They have

not initiated active injury surveillance efforts to determine the true incidence of propeller injuries. Although the number of known cases should have been more than sufficient to stimulate preventive action, manufacturers have not committed appropriate energy or resources to developing ways to reduce or eliminate these deaths and injuries.

TABLE 1.

Struck by Boat or Propeller

Injury and Fatality Totals
U.S. Coast Guard Boating Statistics Data, 1976 – 1990

Year	Fatalities	Injuries	Total
1976	12	112	124
1977	5	107	112
1978	16	95	111
1979	18	69	87
1980	12	88	100
1981	7	83	90
1982	11	66	77
1983	18	113	131
1984	8	79	87
1985	16	98	114
1986	16	133	149
1987	12	155	127
1988	11	40	51
1989	6	60	66
1990	7	180	187
TOTAL	175	1,438	1,613

Clinical Aspects

Surgeons attending patients with propeller injuries report especially severe and disabling wounds. Inertial force, drag and the added mass of the boat affect the dynamics of objects colliding in water so that the force of a collision in water is greater than that of an equivalent collision in air. [Purcell, 1987] The spinning propeller blades strike the human body with the force of both the forward velocity of the boat hull and with their own even greater rotational velocity. After the body is struck by the propeller, the relative viscosity of water can limit the body's deflection, making it more likely to absorb the full energy of the impact. [Hargarten, 1992]

Propeller injuries frequently involve multiple wounds and are often characterized by a series of deep parallel cuts [Romano, 1962], which can lead to traumatic or surgical amputation and significant blood loss; wounds immersed in water tend to bleed more freely, as the body's coagulation time is increased. Long periods of recovery and rehabilitation may be required. [Hargarten, 1992] Water-borne organisms can infect the wounds, further complicating recovery. [Price, 1987; Lineaweaver, 1988]

National costs for the treatment and rehabilitation of propeller injuries have never been estimated. However, in one case series of severe propeller injuries reported by Hargarten et al., the average cost for hospital and physician care alone exceeded $100,000 per injury. [Hargarten, 1992]

TABLE 2.

Struck by Boat or Propeller

Injury and Fatality Rates Per Million Boats
U.S. Coast Guard Boating Statistics Data, 1976 – 1990

Year	Boats x Million	Fatality rate	Injury rate	Total rate
1976	12.8	0.9	8.7	9.7
1977	13.3	0.4	8.0	8.4
1978	13.6	1.2	7.0	8.2
1979	14.1	1.3	4.9	6.2
1980	14.6	0.8	6.0	6.8
1981	15.1	0.5	5.5	6.0
1982	15.5	0.7	4.3	5.0
1983	15.8	1.1	7.2	8.3
1984	16.3	0.5	4.8	5.3
1985	16.7	1.0	5.9	6.8
1986	17.3	0.9	7.7	8.6
1987	17.7	0.7	6.5	7.2
1988	18.4	0.6	2.2	2.8
1989	19.0	0.3	3.2	3.5
1990	19.5	0.4	9.2	9.6

Epidemiology

Between 1976 and 1990, the U.S. Coast Guard officially reported 175 fatalities and 1,438 non-fatal injuries in its annual *Boating Statistics* report category "struck by boat or propeller."[2] During this 15-year period, the reported number of injuries and fatalities varied, with no discernible upward or downward trend. [See Tables 1 an 2; Figures 1 and 2] Annual fatalities ranged from a low of 5 in 1977 to a high of 18 in both 1979 and 1983 (average 11.7 per year), while non-fatal injuries ranged from a low of 40 in 1988 to a high of 180 in 1990 (average 95.9 per year). Based on Coast Guard estimates of the number of recreational boats in the United States, the fatality rate per million boats has varied from a low of 0.3 in 1989 to a high of 1.3 in 1979.[3] The non-fatal injury rate per million boats was at its lowest in 1988 at 2.2 and peaked during the 15-year period in 1990 at 9.2. [USCG *Boating Statistics*, 1976-1990]

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[2] Analysis of the raw (uncompiled) Coast Guard data may reveal a different number of injuries. This report relies upon the aggregated statistics compiled and made available by the Coast Guard, to the public, and to those who formulate boating safety policies. See, for example, *Boating Statistics* data supplied to Congress [USCG, 1988] and to the media. [Williams, 1989]

[3] It is important to recognize that a more accurate measure of exposure, to use as the denominator for a rate calculation, would be person-hours of propeller-driven boating activity, rather than raw numbers of boats. These more precise data are not readily available for each of the past 15 years.

For a number of reasons, Coast Guard data for propeller injuries represent substantial and systematic underreporting.[4] Estimates of the true annual incidence of propeller injuries have been as high as 3,420 in a Coast Guard analysis of its own 1978 data, for a rate of 251 per million boats. [Freund, 1979]

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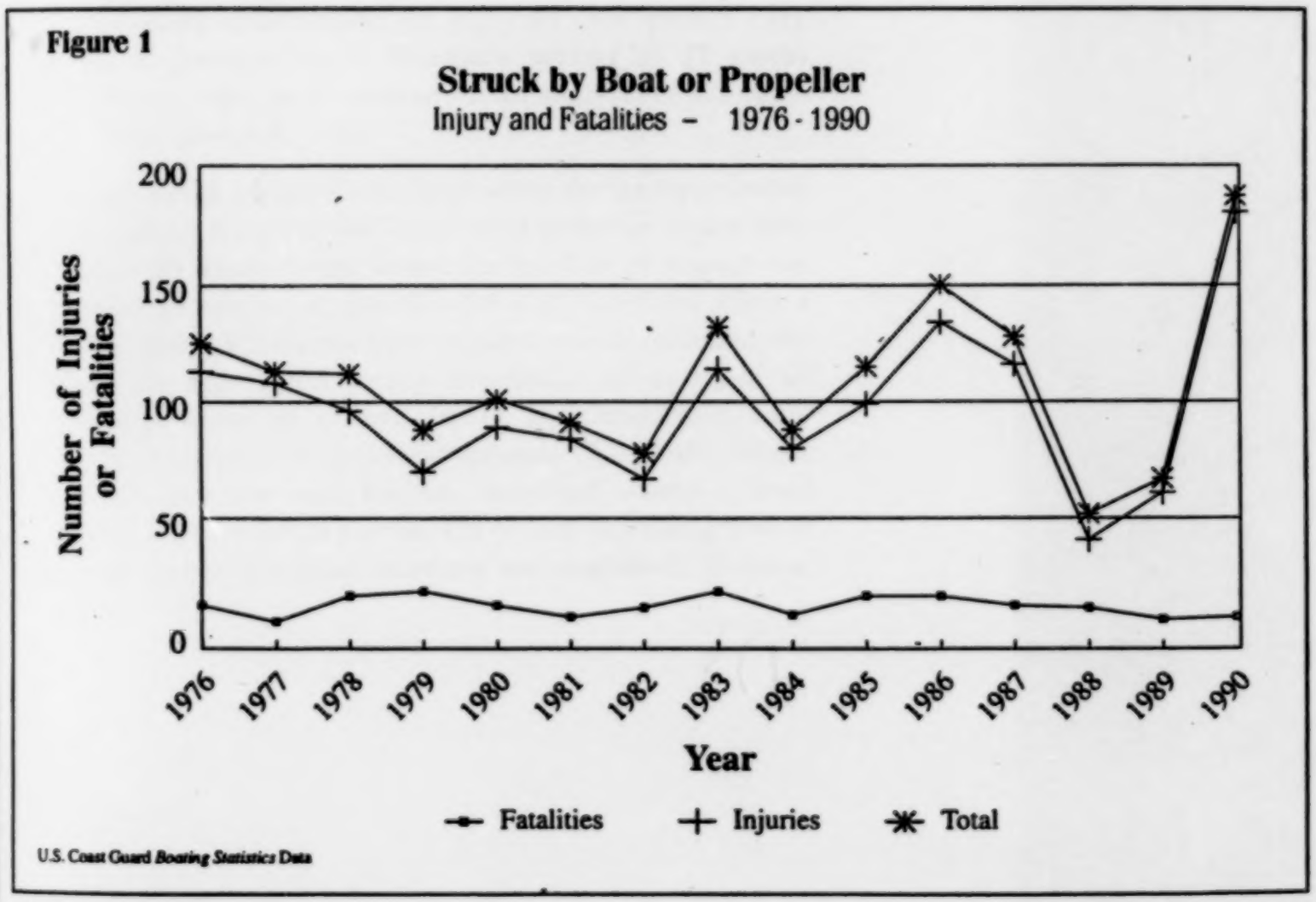
[4] See discussion beginning at page 8, infra.

Figure 1



U.S. Coast Guard *Boating Statistics* Data

Reports in the medical and scientific literature as well as unpublished studies performed by the Coast Guard provide much of our additional understanding of the epidemiology of propeller injuries. Propeller-related case fatality rates[5] based on reported case studies vary from 15 percent (in a literature review of 77 cases) [Kutarski, 1989] to 23 percent (in an analysis of 223 cases in 1978). [Freund, 1979]

Propeller strikes to the head cause the largest number of deaths: a Coast Guard analysis of propeller injury data from 1978 showed that, where the location of impact was known, 39 percent of fatalities (16 of 41) involved solely a head injury. When multiple impacts which included the head are aggregated, nearly two-thirds (27 of 41) of all fatalities involved a head injury. By comparison, only about 5 percent of non-fatal injuries (7 of 144), where impact location was known, involved solely a head injury, with about 15 percent (21 of 144) including a head impact when multiple locations are combined. [Freund, 1979]

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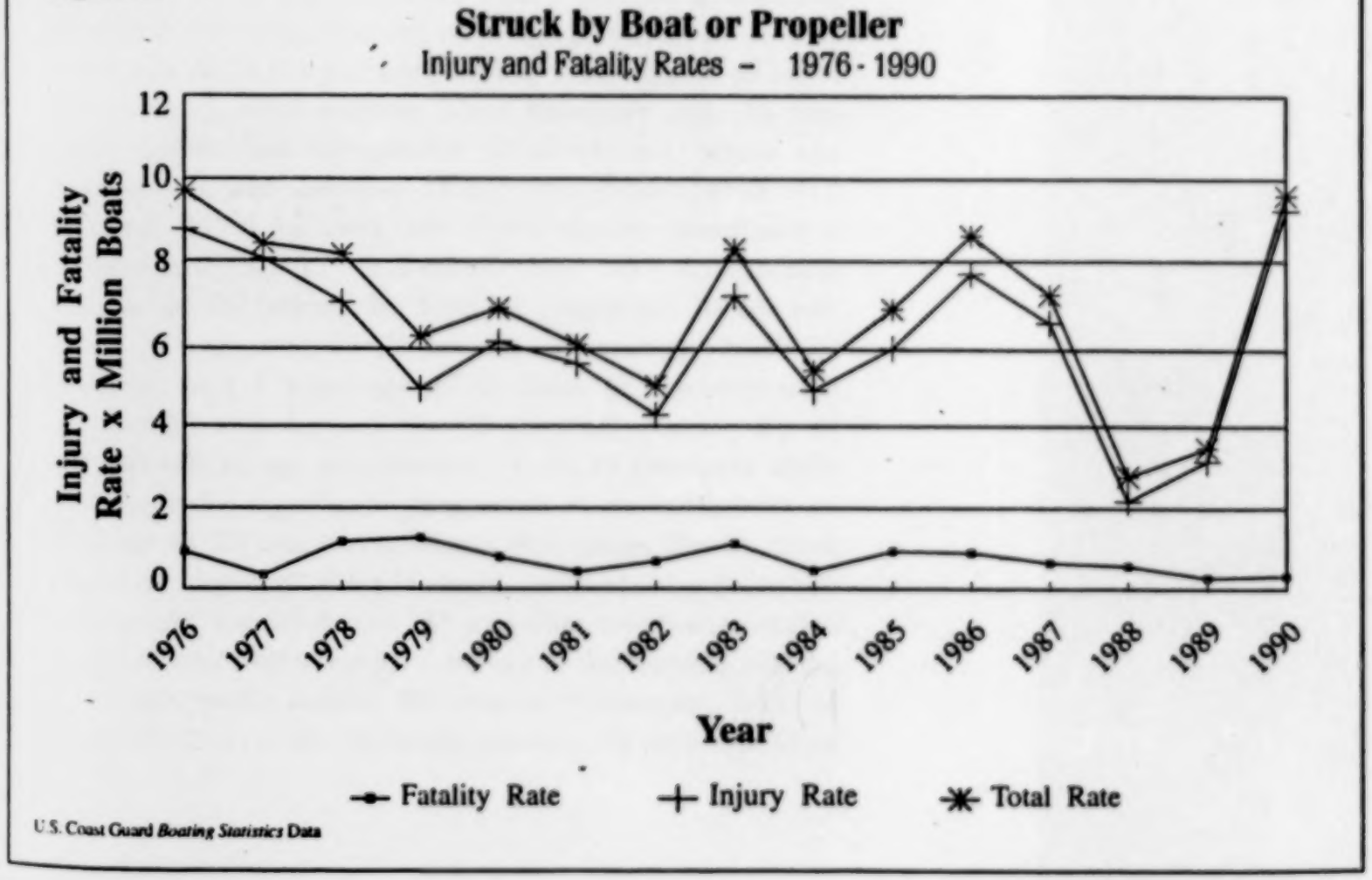
[5] A case fatality rate compares the number of individuals who die from a particular injury or disease to the total number affected within a specified time. Therefore, if a case series reported 20 propeller injuries, 5 of which result in a fatality, then the case fatality rate (over the time frame of the case series) would be 25 percent. [Lilienfeld, 1977]

Figure 2



U.S. Coast Guard *Boating Statistics* Data

Coast Guard annual boating data do not report age and sex breakdowns for the various injury scenarios. In the same 1979 Coast Guard analysis (of its 1978 data), however, 72 of 223 propeller injury victims (combining fatal and non-fatal injuries) were age 0-19 (32 percent); 92 were age 20-39 (41 percent); and 27 were age 40 or older (12 percent), with another 32 of unknown age (14 percent). More than one-quarter of all victims, where age was known, were between 16 and 19 years old (49 of 191). [Freund, 1979] In 1984, the Coast Guard completed a similar analysis of its limited data with comparable results: of 58 "struck by boat or propeller" injury victims[6], 19 were are 0-19 (33 percent); 27 were age 20-39 (47 percent); and 2 were age 40 or older (3 percent), with another 10 of unknown age (17 percent). Among the 48 victims whose age was known, 16- to 19-year-olds again represented a significant proportion of the total, with 11 of those 48 (23 percent) falling in that range. [Traub, 1984] Similarly, one 1987 Florida study, conducted by Price and Moorefield, found that of 195 propeller injuries identified from 1979 to 1983 through a survey of the members of the local orthopedic society, 89 were to victims age 0-19 (46 percent); 65 were age 20-39 (33 percent); 16 were age 40 or

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[6] The 1984 study analyzed only a 25 percent sample of the more than 240 "struck by boat or propeller injuries" contained in the Coast Guard's 1983 data. Of the 58 analyzed, 47 were struck by the propeller, 8 by the boat only, with 3 unknown. Because the study does not separately analyze boat and victim characteristics for struck by boat versus struck by propeller injuries, these data have been aggregated to determine the distribution of this injury scenario.

older (8 percent); the ages of 25 victims (13 percent) were not reported. [Price, 1987]

When data on victim and operator sex are available, males predominate in both categories, probably reflecting the large proportion of young males among participants in motorized water sports. The Coast Guard's 1979 study found that 171 of 222 victims (77 percent) and 197 of 211 operators (93 percent), where sex was known, were male. [Freund, 1979] In the 1984 study, 42 of 58 "struck by boat or propeller" victims (72 percent) were male (operator information was not reported). [Traub, 1984]

Waterskiing is the activity most often associated with propeller injuries. A review of medical and technical literature on water-skiing-related injury reveals that, in a sport fraught with hazards, propeller strikes inflict the most damage. [Paterson, 1971] "Accidents involving propellers remain the chief cause of devastating and mutilating injuries," Banta reported in 1979.[7]

Waterskiers themselves are the victims in about one-third of propeller injury incidents (27 percent in the 1979 Coast Guard analysis and 35 percent in the 1984 analysis). [Freund, 1979; Traub, 1984] Usually a skier is struck by the towing boat or by another boat whose driver fails to notice the downed skier. Price and Moorefield found that 48 percent of their cases involved waterskiing, with another 36 percent resulting from falls overboard. Just over 10 percent occurred to people already in the water,

[7] Some physicians have attributed these injuries to operator negligence or the lack of a vigilant observer in the tow boat. [Grace, 1974; Hummel, 1982]

swimming or diving. [Price, 1987] The 1979 and 1984 Coast Guard studies reported that 48 to 61 percent of all victims were boat operators or passengers; 44 to 57 percent were the operator or passenger of the very boat which struck them. [Traub, 1984; Freund, 1979]

Waterskiing injury scenarios often involve a passenger or operator of a ski boat thrown overboard during sharp turns and rapid acceleration or deceleration, followed by contact with the boat's propeller. Alternatively, the boat may collide with another boat or object while the operator's attention is diverted. The collision then causes a fall overboard and a propeller strike. Some details from a 1987 Coast Guard report illustrate the variety of waterskiing-related accident scenarios:

State	*Date*	*Description*
MA	07.14.84	Ski, passenger thrown out and hit by prop.
NM	08.08.84	Teen, ski, backed up to pick up skier, prop cut person on head.
NY	09.01.84	Teen, skier in water awaiting tow, hit by other ski boat, probably killed by prop.
OR	08.07.84	Teen, ski, passenger on bow, rapid deceleration, falls forward overboard, hit by boat and prop.
TN	07.21.84	Teen, ski, hit a log, passenger on bow thrown out, severe cuts to abdomen, probably prop.

All of these injuries were fatal. [Purcell, 1987]

Waterskiing coupled with today's very powerful marine engines creates an especially dangerous combination. "It is obvious that with the increasing popularity of waterskiing, and with the burgeoning number of boats powered by high speed outboard propellers . . . , we can expect correspondingly large numbers of dramatic accidents to water skiers and passengers in the boats." [Jackson, 1965] This comment was published in 1965, when the number of pleasure boats in the U.S. was about six million. Today, there are more than 19 million. [Red Cross, 1991] Furthermore, the "high speed" propellers Jackson described are slow by today's standards. He described two separate, disabling brain injuries each inflicted by a 25 horsepower motor. More recently, accordingly to Coast Guard analyses, nearly all reported propeller injuries have involved motors of greater than 25 horsepower. For reported injuries and fatalities where horsepower was known, well over half (55-62 percent) of the motors involved were greater than 75 horsepower. [Freund, 1979; Traub, 1984] Many pleasure boats today are powered by engines rated at several hundred horsepower. Information about the speed of boats involved in propeller injuries is also incomplete.[8] In the Coast Guard's 1979 study, boat

[8] The National Boating Safety Advisory Council's 1989 report of its propeller guard subcommittee (see Part Three) claims that "approximately 80 percent of all accidents occur when a boat is operating at speeds in excess of 10 miles an hour . . . " No data or specific citation supporting this assertion were presented. According to the same report, casualties occurring at lower speeds "typically appear to happen when the operator is in the process of picking up a fallen water skier, moving in the vicinity of swimmers, or inadvertently putting an engine in gear when swimmers are using a boarding ladder or platform." [NBSAC propeller guard subcommittee, 1989]

speed in miles-per-hour was known for only 21 of 52 fatalities and 38 of 171 non-fatal injuries. Of the fatalities where boat speed was known, four (19 percent) occurred at speeds between 0-10 mph; 5 (24 percent) at 11-20 mph; 6 at 21-30 mph (29 percent); and 6 (29 percent) at speeds greater than 30 mph. For non-fatal injuries, the distribution is somewhat different, with a greater proportion of incidents at slower boat speeds. Of the 38 injuries where boat speed was known, more than two-thirds occurred at boat speeds of 10 mph or less (26 injuries of 68 percent); 5 at 11-20 mph (13 percent); 5 at 21-30 mph (13 percent); and 2 at speeds greater than 30 mph (5 percent). [Freund, 1979]

Distribution of Propeller Injuries – 1979 and 1984 Coast Guard Studies

1. More than one-quarter of victims were between 16 and 19 years of age.

2. Approximately three-quarters of victims and more than 90 percent of boat operators involved in propeller injuries were male.

3. About one-third of propeller injury victims were water skiers.

4. Most propeller-related fatalities involved a head impact. Fewer than one-fifth of non-fatal injuries involved a head impact.

5. More than half of the boats involved in propeller injury incidents were powered by engines greater than 75 hp.

6. Where precise boat speed was known, approximately 20 percent of fatalities and more than two-thirds of non-fatal injuries occurred at speeds of 10 mph or less.

Vessels involved in propeller injuries are typically in the 15 to 20 foot range – the same range in which most powered boating injuries occur. [Freund, 1978; Traub 1984; USCG propeller guard subcommittee, 1989] Riders of the much smaller, increasingly popular "personal watercraft" or "jetskis" (powered by water jet engines) have also been killed by propellers of other boats following a collision or fall. [Hummel, 1982; Scott, 1989]

No study we located described the temporal or weather-related variations associated with propeller injuries, but it is reasonable to assume that they occur most frequently under the same conditions as other boating injuries – on summer weekends, in good visibility, and in good to fair wind and weather conditions – when boating activity is at its peak. [USCG *Boating Statistics*, 1990; Red Cross, 1991; Baker et al., 1992]

Underreporting

Propeller injuries are an internationally recognized problem. Case reports from the medical literature of Australia, Great Britain, Yugoslavia, the former Soviet Union, Israel, Canada, and most extensively the United States,

document the hazards of unguarded propellers. [Paterson, 1971; Sleight, 1974; Kutarski, 1989; Sustic, 1970; Batinica, 1973; Budrin, 1976; Levy, 1979; Grace, 1974; Mann, 1976; Price, 1987; Lineaweaver, 1988] There is little consensus regarding the actual incidence of propeller injuries, however, because data collection is inadequate and reporting methods unreliable or misleading.

In the United States, the Coast Guard has federal jurisdiction over recreational boating and is required to collect and publish boating accident statistics. [Federal Boat Safety Act, 46 U.S.C. § 4301 *et seq.* (1991)] The Coast Guard collects data on boating-related casualties through a system which requires that the operator of any vessel used for recreational purposes file a report if that vessel is involved in an accident resulting in:

1. Loss of life; or

2. Personal injury which required medical treatment beyond first aid; or

3. Damage to the vessel and other property exceeding $500 ($200 before 1989); or

4. Complete loss of the vessel. [USCG *Boating Statistics*, 1990]

The reports are filed with the authorities of the state in which the incident occurred (or directly to the Coast Guard if in Alaska) and the states provide copies of the accident reports to the Coast Guard. All incidents which meet the federal reporting requirements (above) are included in the Coast Guard's annual *Boating Statistics* compilation.

This system misrepresents the true number of propeller injuries in at least three ways:

(1) The Coast Guard's "type of accident" categories do not distinguish between impacts with propellers and those with the hull of the boat or other underwater appendages. Instead, all such incidents are grouped together as "struck by boat or propeller," in the Coast Guard's annual report.

Inadequacy of Coast Guard Propeller Injury Data

1. The Coast Guard estimates that it receives reports for less than ten percent of non-fatal injuries.

2. The Coast Guard's annual *Boating Statistics* compilation categorizes injuries only by the first event in any injury scenario.

3. *Boating Statistics* aggregates propeller injuries and those caused by contact with the boat hull in a single category, "struck by boat or propeller."

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(2) The "type of accident" tables, which include the category "struck by boat or propeller," refer only to the first event leading to the injury. A fall overboard which was followed by a fatal propeller strike, for example, appears only in the "fall overboard" category, even if it was the propeller strike that led directly to the fatality. In fact, no propeller injury which was preceded by another event for which the Coast Guard has established a separate category (such as capsizing, sinking, or collision with

another vessel) would be classified as a "struck by boat or propeller" incident in the annual *Boating Statistics* report.

(3) The Coast Guard estimates that it receives reports for only five to ten percent of non-fatal reportable injuries[9] (reporting on fatal injuries is believed to be fairly complete). [USCG, *Boating Statistics*, 1979-90] While the agency is to be commended for its candor in admitting the reporting rate for non-fatal injuries, it should not be satisfied with this low level of reporting, nor can it formulate reliable injury prevention policy without more complete data. In fact, in order to improve the completeness of its non-fatal propeller injury data, the agency's own 1987 study recommended that the Coast Guard should begin active random sampling of hospital emergency rooms "rather than the passive voluntary collection of reports that is presently used." To date, it has not done so.[10] In addition, according to the same study, the quality of individual case reports "varies from an official Coast Guard inquiry to the scribblings of an inebriated teenager." [Purcell, 1987]

Next to the non-reporting of many incidents, classification of "accident type" by the first event leading to the injury is perhaps the most serious factor in the Coast

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[9] It has been suggested, however, that the likelihood of reporting for non-fatal injuries is correlated to the severity of injury, so that the Coast Guard data may include more of the most severe propeller injuries. No data supporting this suggestion were located. Furthermore, even lesser (though still serious) injuries are worthy of enumeration and prevention.

[10] A study which does utilize more active data collection is currently being conducted by the Centers for Disease Control with Coast Guard funding. See pages 29-30, infra.

Guard's official underreporting of propeller injuries and serves to disguise the true number of deaths and injuries caused by propellers. An analysis of Coast Guard data for 1983-1987 found that less than half (45 percent) of 1,304 casualties which involved "struck by boat or propeller" were classified as such in the published statistics for those years. Another one-third of these underwater impact cases were coded as "falls overboard" because that was the first event in the injury scenario. More than one-tenth began with a "collision with another vessel or fixed object." [Kerlin, 1988] The Coast Guard's unpublished 1978 analysis of its own accident reports discovered 52 fatalities and 171 injuries caused in whole or in part by propeller strikes; the Coast Guard's *Boating Statistics* report for that year, however, lists just 16 fatalities and 95 injuries as "struck by boat or propeller." Therefore, coding by "first event" caused even known propeller strikes to be underreported by about two-thirds for fatalities, and by about half for non-fatal injuries. In fact, the actual number of non-fatal propeller injuries may have been as high as 3,420, the report states. This assumes that the 171 reported to the Coast Guard[11] represent as few as 5 percent (due to non-reporting) of all non-fatal injuries. [Freund, 1979]

In 1984, the Coast Guard repeated this analysis with similar results. Although it analyzed only a 25 percent sample of the 246 "struck by boat or propeller" deaths and injuries for 1983, this study found 11 propeller-

[11] This figure includes those propeller injuries that were retrieved from other Coast Guard categories both which were initially coded by some other "first event."

related fatalities and 35 non-fatal injuries, for an estimated reported total of 184. However, the Coast Guard's *Boating Statistics* report for 1983 lists just 131 (18 fatal and 113 non-fatal) injuries in the "struck by boat or propeller" category. [Traub, 1984; USCG *Boating Statistics*, 1983]

A 1991 Red Cross "National Boating Survey," supported by a Coast Guard grant, further illustrates the magnitude of the Coast Guard's official underreporting of propeller injuries. The Red Cross study employed a telephone survey of a statistically representative group of boating and non-boating households. A total of 3,700 boating households answered the survey questions, and from this group national estimates were extrapolated. Survey respondents were asked to report their involvement in any "critical incidents or accidents" from October 1, 1988 to September 30, 1989. A "critical incident or accident" could range from an accident involving personal injury or property damage to a scenario in which the respondent "thought a dangerous situation might develop but didn't." Finally, respondents were asked to provide additional information about the most severe critical incident or accident in which their household was involved during the study period.

The Red Cross survey estimated that 236,599 reportable incidents (according to the Coast Guard's reporting criteria) occurred during the one-year study period. During the same period, the Coast Guard received reports for only 6,060 reportable incidents. Assuming, as the Coast Guard asserts, that Coast Guard statistics for fatal injuries are fairly complete (even though some propeller fatalities are "hidden" due to first event coding) then the Coast

Guard actually receives reports for only about 2.5 percent of all non-fatal incidents. [Red Cross, 1991]

Noting that "the most devastating types of injuries result from propeller contact and high speed impact," the Red Cross study separated "struck by boat" and "struck by propeller" injuries, and estimated that 2,013 reportable and 4,022 unreportable (not meeting Coast Guard reporting criteria) deaths and injuries associated with propeller contact were sustained during the one-year study period.[12] The Red Cross estimates, although based on a small sample of propeller injuries, correspond to an annual rate that is at least 34 times the 117 deaths and injuries in the category "struck by boat or propeller" reported by the Coast Guard for *all* of 1988 and 1989.

Two independent studies also demonstrate that the Coast Guard has not accurately monitored and reported the true incidence of propeller injuries. Price and Moorefield surveyed members of the Florida Orthopedic Society and, with a 50 percent response rate, discovered 195 propeller injuries from 1979 to 1983 – nearly six times the number of vessels involved in "struck by boat or propeller" incidents reported to the Coast Guard during the same five-year period in Florida. (The Coast Guard annual report provides type of accident breakdowns for each state only by the number of vessels involved.) [Price, 1987; USCG *Boating Statistics*, 1979-1983]

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[12] The Red Cross study does not report confidence intervals for its national injury estimates. Given the small number of propeller injuries actually identified through the survey (less than 10), the confidence intervals may be quite broad.

Propeller Injury Data and Estimates

1. Based on Coast Guard reports of 171 non-fatal propeller injuries, and the assumption that these reports may represent only 5-20 percent of non-fatal injuries, Freund estimated between 855 and 3,420 such injuries for 1978. The Coast Guard officially reported 95 "struck by boat or propeller injuries" in 1978.

2. Based on a nationwide representative survey, the Red Cross estimated 2,013 propeller deaths and injuries occurring in the one-year period between October 1, 1988 and September 30, 1989. The Coast Guard officially reported just 66 "struck by boat or propeller" deaths and injuries for 1989.

3. Based on a survey of the members of the Florida Orthopedic Society, Price identified 195 propeller injuries in Florida alone between 1979 and 1983. The Coast Guard officially reported just 34 "vessels involved" in "struck by boat or propeller" injuries in Florida for those years.

Hargarten et al. examined data from four different sources to determine the number of fatalities and injuries due to propeller strikes in Wisconsin from 1987 through 1989. They used death certificates, the Wisconsin Department of Natural Resources (DNR) boating accident files, the U.S. Coast Guard boating statistics for Wisconsin, and a survey of emergency department medical directors at 126 acute care hospitals within the state. The U.S. Coast Guard reported only five "vessels involved" in a "struck by boat or propeller" incident in Wisconsin during the study period, by comparison with 23 deaths and injuries

identified through DNR records and 14 non-fatal injuries discovered by the state emergency department survey. The number of vessels involved in propeller injuries reported by the Coast Guard was, therefore, less than 25 percent of the deaths and injuries reported by the Department of Natural Resources and 36 percent of those from the survey of emergency departments. [Hargarten, 1992]

Based on these studies, the number of people injured and killed by motorboat propellers could range from 4.6 [Hargarten, 1992] to 34 [Red Cross, 1991] times the number listed as "struck by boat or propeller" in *Boating Statistics* for any year.[13] Using the factor of six determined by Price and Moorefield (with only a 50 percent response rate), estimates for fatal and non-fatal propeller injuries combined would range in the last decade from a low of about 300 in 1988 to a high of 900 in 1986. Even more dramatically, using the factor of 34 derived from the Red Cross survey, there would be an estimated 54,842[14] fatal and non-fatal propeller injuries for the years 1976 to 1990, or an average of more than 3,600 per year. This figure is consistent with Freund's 1978 estimate of as many as 3,420 injuries per year, although it is unlikely that the level of underreporting would remain constant from year to year.

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[13] There are limitations associated with comparing injuries (from the state studies) with "vessels involved" (from the Coast Guard *Boating Statistics* state data), but the general magnitude of Coast Guard underreporting is still evident.

[14] This figure is derived by multiplying the Coast Guard's officially reported 15-year total of 1,438 propeller injuries by 34.

Conclusion

Propeller injuries present an often devastating and costly clinical picture, demanding a clear understanding of their incidence, distribution and risk factors. The Coast Guard substantially and systematically underreports the number of propeller injuries in the United States. Data from a number of sources, including special Coast Guard reports, indicate that the true number of propeller injuries and fatalities may be closer to the 2,000-3,000 per year estimated by the Red Cross and Freund than to the approximately 100 per year officially reported by the Coast Guard.

The Coast Guard generally points to the steady decline in the overall boating fatality rate (for all accident scenarios, expressed as deaths per 100,000 boats) as evidence of the increased safety of recreational boating and the effectiveness of its safety programs. Even as underreported in Coast Guard data, however, no downward trend is evident for propeller-related deaths and injuries. [See figures 1,2] Even if some downward trend were discernible, however, the personal and social costs associated with propeller injuries are unacceptable, given the strong prospects for their prevention.

Part Two

Preventing Propeller Injuries: Feasibility of Countermeasures

Introduction

The large number of severe and fatal injuries caused by propellers demands a thoughtful and effective injury

prevention strategy. Although a 1984 Coast Guard study concluded that operator training would have made no difference in the vast majority of propeller injury incidents,[15] [Traub, 1984] both marine engine manufacturers and the Coast Guard have continued to stress operator training and improved enforcement of boating regulations as the best way to reduce the incidence of propeller injuries and fatalities. [NBSAC propeller guard subcommittee, 1989] Neither of these approaches, however, can guarantee that a person will not be in the path of a boat driven by a drunk or simply inattentive operator. Furthermore, with an estimated 19 million recreational boats in the United States, the number of potential operators requiring training is very large. And, in scenarios involving a fall overboard, in the few seconds between the fall and contact with the boat's propeller, operator training is probably of little value. Finally, as the Coast Guard's own 1979 propeller injury study explained, a major difficulty with an education strategy is that "there is no particular operator or victim characteristic that produced a large number of propeller-related accidents. Further, the accident scenarios are diverse." [Freund, 1979]

Enforcement of current boating laws has proved difficult in the recreational settings in which many propeller injuries occur – on crowded waterways, well off shore, and often under the influence of alcohol. In fact, alcohol is implicated in as many as two out of three boating

[15] Research in motor vehicle crash injury reduction has also demonstrated that operator training programs alone are relatively ineffective and may even enhance the risk of injury by increasing operator exposure. [Robertson, 1992]

fatalities. [Metropolitan Life Insurance Company, 1984; National Committee on Injury Prevention and Control, 1989] In some areas, 40 percent of operators involved in boating fatalities were judged to be legally drunk. [Metropolitan Life Insurance Company, 1984; Peeler, 1990] While a number of states outlaw operating a boat while intoxicated, marine police enforcement has generally been understaffed and may identify the impaired operator only after an injury has occurred.

Automatic protection

Rather than focusing primary attention on attempting to modify the behavior of potential victims through training or education, the most successful injury prevention approaches rely on automatic or passive protection, requiring no action by the potentially injured person to prevent that injury. [Robertson, 1984; Haddon and Baker, 1981; Kelley, 1975; Haddon, 1970] For product-related injuries, automatic prevention generally involves changes in product designs in order to protect everyone at risk. [National Research Council, 1985; Baker et al., 1992]

In order to better systematize thinking about potential modes of injury prevention, beginning in the 1960's William Haddon devised and refined a list of ten types of strategies to reduce or eliminate injuries. Each is concerned with managing the energy release which produces injury or with ameliorating the consequences of the transfer of energy to people.[16] [Haddon, 1970] In the context of

[16] For additional information on the use and importance of the Haddon strategies for injury control, see: Haddon, W., On

propeller injuries, Haddon's first and sixth strategies (preventing the marshalling of the energy in the first place and interposition of a material barrier to separate humans from the energy exchange) have the most relevance. These strategies are exemplified by employing water jet propulsion to eliminate propeller blades and by installing propeller guards to separate humans from the source of injury.

Strategies for Preventing Propeller Injuries

1.	Non-Automatic:	Educate boaters and potential victims to alter their behavior.
2.	Automatic:	Replace propeller blades with water jet engines.
		Separate people from propellers with propeller guards.
		Make propeller blades themselves safer.

The public health practice of injury control has demonstrated that automatic injury intervention strategies are the most effective.

Eliminating Propellers: Water Jet Propulsion

Technology to eliminate propellers entirely has been available for many years through the use of water jet

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the Escape of Tigers, *Technology Review* 72 (7) May 1970; National Committee for Injury Prevention and Control, Injury Prevention: Meeting the Challenge. Oxford University Press, 1989.

propulsion. [Barham, 1976] At the most basic level, a water jet functions by scooping water into internal pumps which had energy and expel the water through a nozzle. The outgoing water is discharged with a greater velocity than that of the incoming stream and thrust is achieved. [Brandau, 1967]

By the early 1950's, a few manufacturers began to make water jet propulsion units available to recreational boaters in the U.S. market. [Barham, 1976] However, the Mercury Marine division of the Brunswick Corporation (makers of Force, Mariner and Mercury outboard motors) and the Outboard Marine Corporation (OMC, makers of Johnson and Evinrude engines), which together control approximately 85 percent of the U.S. marine recreational propulsion market, do not currently offer jet drive units for use on recreational boats.

A 1973 Mercury Marine internal memorandum, however, described a test of the performance characteristics of a "Hall jet" (apparently manufactured by another company). The test report noted both the improved maneuverability and worsened fuel efficiency of a boat equipped with the jet drive and concluded that "the concept of an outboard jet is good, being able to operate in areas a propeller cannot. Further, it is our feeling that the jet unit we tested could be improved upon." [Schenk, 1973] In 1974, an OMC engineer reported that the water jet has "distinct advantages in the areas of mechanical simplicity and freedom from damage by underwater objects. It also has the ability to accelerate a boat to

planing[17] speed more rapidly, and can plane a heavier load than an equivalent propeller driven boat." The author asserted that the jet is not as efficient as a conventional propeller at lower speeds, and is less maneuverable and noisier, but concluded that "in the future, improvements will be made in the design and performance of both water jet and propeller driven units . . . " [Lambrecht, 1974]

Today, however, outboard and inboard motors equipped with propellers remain the primary propulsion system for recreational boats. Water jet propulsion is not in wide use for pleasure craft other than in "jet-skis" or other "personal watercraft." American Suzuki Motor Corporation offers three models of a jet drive system for use on recreational boats, but so far has not made significant inroads into that market. The 1991 Red Cross boating survey estimated that 249,000 personal watercraft were equipped with a jet drive, compared with only 153,000 jet drives associated with all other boats. Therefore, of the more than 19 million boats in the United States, less than three percent are equipped with a jet drive. [Red Cross, 1991]

Separating Propeller Blades from People: Propeller Guards

If most boats remain propeller-driven, automatic protection from propeller injuries can be achieved with the

[17] When a boat gains enough speed to skim on the surface of the water it is said to "plane." [Noel. 1988]

placement of a shield between people and spinning propeller blades. Placing a material barrier between humans and potentially injurious energy transfers has a long history as a successful injury control measure. Guards are used to separate an operator's hands from spinning tablesaw blades, lawnmowers are equipped with footguards to protect an operator's toes from the blades, and air bags come between human bodies and injurious contact with an automobile's interior structure.

Private entrepreneurs have been refining guards for motor boat propellers since at least 1910. With the exception of several short-lived projects from OMC and Mercury Marine, however, major marine propulsion manufacturers have not committed significant research and development resources to design and test devices intended to lessen the dangers of unguarded propellers.

Propeller Guard Patents and Private Entrepreneurs

In the United States, the U.S. Patent and Trademark Office evaluates new technologies seeking patent protection. In order to gain such protection, a device must be novel, not obvious, and "fully enabling" – able to perform as claimed in the patent application. When a patent is granted, this generates a presumption that the invention is feasible. [Patent and Trademark Office, 1987]

Since 1910,[18] at least 21 patents have been awarded by the U.S. Patent Office for propeller guards designed to

[18] The earliest "propeller guard" patent we located was awarded to J.L. Hawthorne in 1910. [Hawthorne, 1910] The device featured a rectangular guard frame attached to the boat hull and extending beneath the propeller. When the frame

separate outboard motor propellers from persons or other objects in the water. The primary stated objective of most of these patents is to protect the propeller blades from damage. Nine of the patents, however, describe "protecting personnel in the water " as an important objective for the invention. All of the patents implicitly recognize that it is possible and desirable to separate propellers from other objects, including human beings.

The inventions fall into three major configurations: 1) guards completely surrounding the propeller with bars or wire mesh intended to allow water to pass through but prevent human contact with the propeller blades (so-called "catcher's mask" or "cage" guards); 2) guards in the shape of a ring which surrounds only the outside edge of the propeller; and 3) guards which wholly enclose the propeller within a tunnel or tube, commonly referred to as a "Kort nozzle." (A Kort nozzle also functions to funnel water toward the propeller blades in order to increase engine efficiency at low speeds.) [U.S. Patents, 1910-1991; NBSAC propeller guard subcommittee, 1989; Seidman, 1992]

In 1955, Theodore Francis Crew patented a device resembling a screen or cage that would surround an outboard motor propeller. The object was to "provide means for completely housing the propeller and drive mechanism of the motor to prevent the loss or injury of the hands, arms, legs, or other parts of the body of those

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struck an underwater obstruction (such as a submerged rock), the device caused the propeller to swing up and over the obstruction to prevent contact.

who may accidentally come in contact therewith during the operation of the motor." [Crew, 1955]

"Boating accidents due to injuries to persons coming in contact with the rotating propeller, while swimming adjacent to the boat, have increased to a point that protection is required to prevent such injuries," reported Frank Hogan in a patent awarded in 1963. His patent for a cage-type propeller guard was intended to ensure "absolute protection against accidental bodily contact with a whirling propeller." [Hogan, 1963]

OMC's 1981 patent for a ring-shaped guard was designed for "augmenting propeller thrust and/or guarding the propeller against underwater obstructions." No discussion of any human protection capabilities of the guard is included. [Holtermann, assignor to OMC, 1981]

In 1987, Dennis Eller patented a ring-shaped propeller guard as "a personal safety feature," noting that "water skiers and other swimmers have been accidentally injured by boat propellers which are unprotected."[19] [Eller, 1987]

Taking a somewhat different approach, in 1991 Lawrence Thibault and Richard Pollini of the University of Pennsylvania (to which their patent was assigned) developed a "safety propeller." recognizing that "the rapidly turning propellers . . . pose a constant threat of serious bodily injury," their patent featured a single ring attached to the distal end of the propeller blades, able to spin with

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[19] Eller's guard also sought to improve the performance of the engine by channeling water more efficiently rearward of the propeller.

the blades. The design employed a number of potential systems to manage the energy of an impact so that it would "substantially reduce or mitigate serious injury resulting from the collision of power boat propellers with humans or animals." Thibault reports that the "safety propeller" can provide "sufficient energy absorbing capacity to significantly reduce injury to the human skull when the boat was moving at 30-35 mph," with only about an eight percent loss in power. [Thibault, 1991]

Small businesses and private entrepreneurs have also developed and marketed propeller guards. In 1978, San Diego boater Bryan Chadwell designed a propeller guard – a cylindrical stationary plastic ring surrounding the tips of the propeller blades. By 1986, Chadwell had refined his design and by 1988, more than 2,000 Chadwell guards were in use by the United States armed forces and by surf lifeguard services in Australia, New Zealand, and California. [Hogan, 1989; Chadwell, 1992] Recently, Marinemotive Engineering, a California company, marketed a product called a "Prop Mate." Advertising material for this double ring-shaped guard promised that "installation of Prop Mate on outboards, inboards and stern drive vessels can greatly reduce blade injuries to human and marine life"[20] while providing enhanced

[20] In fact, most Florida manatees bear scars or other deformities as a result of propeller or boat hull impacts. These scars are so common that they are used as a means to identify individual animals, with more than 900 individual animals so catalogued as of 1985. [Florida Light and Power, 1987; Reid, 1986] In an effort to avoid propeller injuries to manatees, at least one NASA ship employs a wholly enclosed propeller while operating in manatee waters.

propeller thrust and substantial fuel savings. [Marinemotive Engineering, Inc., 1990]

Hydrodynamic Tests and Analyses of Propeller Guards

In order to be accepted for use as an effective injury prevention device, propeller guards must not only prevent or lessen injury to foreseeable victims, but must also permit the boat/motor combination to function within acceptable limits. Boat engine manufacturers have argued that any propeller guard would unduly compromise the top speed and fuel efficiency of a recreational boat. They have also claimed that the greater underwater drag associated with guards can result in worsened or unpredictable boat handling characteristics. [NBSAC propeller guard subcommittee, 1989; Elliott, 1989]

Primarily in connection with litigation directed against engine manufacturers (principally OMC and Mercury Marine), a number of analyses of the hydrodynamic feasibility of propeller guards (including on-water tests of existing guards) have been conducted.

Robert Taggart Report

In 1979, Robert Taggart, a marine engineer, assessed propeller guard technology in "Review of the State of the Art of Swimmer Protection From Outboard Motor Propellers." He sought to determine whether a propeller guard which offered adequate protection without unduly compromising the propulsive efficiency of the boat and motor was within the state of the art. [Taggart, 1979]

Taggart initially determined that to protect persons in the water from propeller blades, the guard should at least surround the outer rim of the propeller (as a ring guard does) and that guards on the suction and discharge sides of the propeller were also desirable (as in a cage or "catcher's mask" configuration). [Taggart, 1979] Many of the propeller guards developed and patented in the last 50 years have these features. [U.S. patents, 1938-1991]

Taggart recognized that a propeller guard's effect on the propulsive efficiency of an outboard motor would be important to its acceptability: if a guard prevents the motor from delivering adequate propulsive thrust, he reasoned, no recreational boater would use it. Based on the self-imposed criterion that a guard may not detract at all from an outboard motor's propulsive efficiency, he concluded that no design manufactured at that time was hydrodynamically acceptable.

However, Taggart found that a propeller guard capable of adequate protection as well as propulsive efficiency had been within the engineering state-of-the-art since 1970. Knowledge regarding propulsor design "was such that adequate technology existed and was available in the open literature to design personnel protective devices for outboard motor propellers that would render these propulsors not only safer but more efficient. . . . Had it been the intent of an outboard motor propeller designer to provide swimmer protection, there was available to him in 1970 all of the technology required." [Taggart, 1979]

Outboard Marine Corporation Tests

Beginning in the late 1970's, Outboard Marine Corporation conducted a series of tests intended to assess the hydrodynamic performance characteristics of various propeller guards.

in 1978, OMC reported on its Project 441, "Propeller Guard Efficiency." The project's stated objective was to "minimize the performance penalties of a Kort nozzle or shroud device at normal runabout speeds." [OMC, 1978] OMC engineers tested the performance of a number of different guard designs for use with a 70 horsepower motor. They were especially concerned with the guard's effect on the top end speed of the boat and reported only these data. The most efficient guard tested reduced top end speed by 2.6 mph (from 36.7 mph to 34.1 mph), or 7.1 percent. The report concluded that "although this base ventilated nozzle was most successful in our tests, it does not necessarily constitute the optimum design. Undoubtedly further improvement in performance could be made, although it is questionable if that improvement would be very significant."[21] [OMC, 1978]

In 1977, OMC received a letter from its Australian division describing a combination ring and cage guard which local surf rescue squads were successfully employing. [Outboard Marine Australia Pty. Limited, 1977] In

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[21] In 1981, OMC obtained a patent on the "propeller shroud" developed in Project 441 [Holtermann, assignor to OMC, Patent 4,304,558,1981], but has never offered it for sale with OMC engine products.

response, on October 22, 1979, OMC conducted tests comparing the Australian guard with its own guard, primarily intended for specialized use in small fishing boats. The tests demonstrated a 4.1 mph full throttle speed loss for the OMC guard (from about 28 mph to 24 mph, or 14 percent) and a 5.9 mph speed loss for the Australian guard (from about 28 mph to 22 mph, or 21 percent). [OMC, 1979]

For a 1980-81 OMC propeller guard test designated as Project 443, the stated objective was "to determine if the performance of an outboard motor used for water skiing would be unduly compromised by a guard which gives a high degree of protection from personal contact with the propeller." [OMC, 1981] Project 443 tested a guard offering even more personal protection by preventing axial as well as radial access (from the front as well as from the side) to the propeller of a 100 horsepower motor. The results showed a top end speed loss of 5.9 mph (from 39.2 mph to 33.3 mph, or 15 percent) and a reduction in fuel efficiency ranging from 18 to 31 percent. The OMC engineers also attempted to compare the static thrust generated by the motor with and without a guard. Initially, the guarded motor achieved greater thrust, but then the guard broke apart. The engineers concluded that "to be practical the guard would have to be strengthened . . . which would make manufacture more difficult and costly," [OMC, 1981]

Following these tests, OMC canceled Project 443. Silas Metcalf, an OMC engineer, later testified in a court case that the project was discontinued because it "had reached the point of no returns and there was no conceivable way that this project . . . then or now, could have met

the objective." [Beech, 1989] Today, OMC does not offer any propeller guards for pleasure planing craft intended to protect people in the water.

Mercury Marine Tests

In 1989, a lawsuit filed against the Brunswick Corporation claimed that its Mercury Marine division was liable for propeller-related injuries sustained as a result of Mercury's failure to guard one of its outboard motors. [*Pree v. Brunswick Corp.*, Cause No. 89-1996-C-1 (U.S. District Court, E.D. Missouri, 1989)] During the discovery phase of that litigation, Mercury Marine was asked to describe all of the propeller guard feasibility testing it had ever conducted. It responded with a list of ten projects from 1973 to 1990. Some involved tests of water jet propulsion devices. A brief description of several others will illustrate Mercury's test program.

A May 10, 1973 Mercury Marine report described a performance comparison test of a Tamco Sea Ray Boat powered by a Merc 75 engine with and without a propeller guard. The precise design of the guard was not specified, but the test reported a speed loss with the guard of 1.4 mph (16.5 mph compared to 15.1 mph, or 8.5 percent) at wide open throttle. Steering performance was described as "satisfactory." [Mercury Marine, 1973]

In March of 1974, Mercury again tested a propeller guard of unspecified design. The guard was installed on a Merc 110 engine and tested on a 12-foot Alumicraft boat. After 21 running hours, the test reported a loss in top speed of 4 mph (from 21.6 mph to 17.6 mph, or 18.5 percent). The report also described difficulties with the

guard becoming clogged with weeds and other underwater debris. Maneuverability of the boat was again characterized as "satisfactory" with "no noticeable change in turns." The report concluded that the guard "can be successful in protecting the prop in limited conditions such as rocks and stumps without limbs or small extensions. If this is to be an accessory item I feel the consumer should know of the full throttle performance deterioration and its ability to collect weeds excessively." [Mercury Marine, 1974]

In 1980, Mercury Marine conducted tests of a Williams propeller guard – a ring-shaped guard whose inventor (not affiliated with Mercury) apparently promised improved boat performance characteristics for his guard. Test runs employed a variety of boat and engine combinations. Top end speed loss ranged from 6.5 mph (15.5 percent) to 9.9 mph (20.2 percent), depending upon which boat and engine combination was tested. The report concluded that the improved performance claims for the Williams guard were false. It did note, however, that "at boat speeds under 28 mph the guard sacrifices very little" and "may decrease the chance of propeller damage in shallow rocky water and it may or may not decrease the risk of limb amputation if struck." [Mercury Marine, 1980]

During the Fall of 1988, Richard Snyder, principal engineer for product evaluation at Mercury marine, began work with the U.S. Marine Corps to develop an improved propeller guard for use on their small, beach assault craft. He designed several different cage guards and contracted with the Wald Wire and Manufacturing

Company in Oshkosh, Wisconsin to construct the prototypes. In tests supervised by the Marine Corps, a boat equipped with the Snyder/Wald cage suffered a lost in top end speed of 11 mph (from 37 mph to 26 mph, or 30 percent); its maneuverability was not impaired. The test report recommended further testing and concluded that "we are very close to the solution of what needs to be the configuration of the prop guard . . . " [Snyder, 1989]

Like OMC, Mercury does not yet offer any safety-oriented propeller guards for the recreational market.

Chadwell Guard Tests

Beginning in 1986, a series of tests were performed with first- and second-generation Chadwell guards to determine their effect on boat speed, handling, and engine fuel efficiency. These tests were performed by experts employed by attorneys involved in propeller injury litigation.

In February 1987, John Hill, a naval architect and marine engineer, reported the results of tests commissioned by a plaintiff's attorney and performed in December 1986 of several propeller guard designs, including the Chadwell ring guard. Hill determined that:

1. The time required to reach planing speed from the rest position was unchanged or reduced with the use of a Chadwell guard compared with an open propeller.[22]

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[22] Hill reported that this is consistent with the documented fact that a ducted propeller produces more thrust and dynamic lift for the boat at low speeds. [Hill, 1987]

2. Boats equipped with a fixed guard (like the Chadwell guard) exhibited improved handling performance resulting from the greater effective rudder area.

3. The stopping ability of the boat improved.

4. Visibility was enhanced while the boat was on plane.

5. The top end speeds of the boats were lower (a reduction of 3.8 mph, or 11 percent) and their fuel consumption was greater.[23]

Hill concluded that "the tested fixed guards are hydrodynamically acceptable for use on planing pleasure craft, considering the intended uses and environments in which pleasure planing craft will be operated." [Hill, 1987]

In April and May 1987, Arthur Reed, also a marine engineer and naval architect, performed another series of tests on behalf of an injured plaintiff to evaluate the hydrodynamic characteristics of propeller guards. Reed equipped a Boston Whaler alternately with a 70 hp and a 150 hp outboard motor; then he ran the boat with and without an improved Chadwell guard. In "Comparative Performance Tests with a Second Generation Chadwell Propeller Guard," Reed concluded:

1. At low to moderate speeds, use of the guards resulted in higher speeds for the same RPM, compared to an unguarded configuration.

[23] These speed losses, however, were reported to be no greater than those ordinarily resulting from adding extra passengers or equipment to the boat. [Hill, 1987]

2. The presence of a guard caused a loss in top end speed of from five to seven percent. This loss was of the same order as might occur due to a non-optimum trim[24] setting.

3. The guards caused the boats to run at a more level trim. This may enhance safety as a result of improved operator visibility.

4. There were no significant differences in boat maneuverability between the guarded and the unguarded configurations, although the guarded boats were able to run tighter circles due to a decrease in the tendency of the boat to sideslip.

5. A boat with a guard was able to tow a waterskier successfully. [Reed, 1987]

In October 1987 and then again in June 1989, also in the context of litigation, Mercury Marine conducted its own tests of the hydrodyamic characteristics of boats equipped with Chadwell guards. The trials employed a variety of boat and engine configurations.

For the 1987 tests, losses in top speed for guard-equipped boats ranged from 4.3 mph (from 41.3 to 37.0 mph, or 10.4 percent) to 12 mph (from 55.0 to 43.0 mph, or 22 percent). Descriptions of the handling characteristics for the guarded versus unguarded boats varied from no significant difference to "very dangerous" (for a Chaparral boat equipped with a guarded Mariner 90 horsepower engine, which was described as listing to the

[24] "Trim" is the front to back inclination of a boat. The angle of trim is the angle between the plane of flotation and the mean waterline plane. [Noel, 1988; Watson, 1991]

starboard side at "an extremely uncomfortable angle"). [Mercury Marine, 1987]

The 1989 tests, supervised by Brian Chadwell, examined a number of different guards including improved Chadwell cage-type guards. Compared with an unguarded boat, the boat equipped with Chadwell guards experienced a loss in top speed of 6.5 mph (from 38.9 to 32.4 mph, or 16.7 percent). At an engine rating of 4000 RPM, the speed loss was only 2.8 mph (from 26.7 to 23.9 mph, or 10.5 percent). The report also noted that, compared with other guards tested, "[i]t was the consensus that the cages offered the least amount of steering torque (like no guards at all) . . . " [Mercury Marine, 1989] The guarded boat experienced a 0.4 miles per gallon reduction in fuel efficiency (from 2.5 to 2.1 MPG, or 16.0 percent), when both boats were compared at the same RPM (about 4500).

Propeller Guard Protective Effect Testing

Motor boat engine manufacturers have argued, often in the context of litigation arising from a propeller injury, that propeller guards themselves can be as or more hazardous than an unguarded propeller, replacing the risk of lacerative injuries from the propeller with that if severe blunt trauma from the guard. Propeller guarding advocates have argued that guards will eliminate serious injuries at low to moderate boat speeds and that serious or fatal injuries, due to contact with the guard, will only occur at relatively high boat speed. Since at least 1980, a number of tests have been conducted to assess these arguments.

Richard Snyder "Sausage Tests"

In 1980, Richard Snyder, at Mercury Marine, performed a series of tests intended to assess the ability of a propeller guard to protect or to harm a person in the water. He used a 2-foot-long by 3-inch-diameter summer sausage packed in an animal skin casing to simulate a human limb. The sausage was skewered on the end of a 1/2-inch wooden dowel and held in a controllable horizontal position under the water. An 18-foot V-bottom boat powered by a 140 hp engine ran over sausages at 4 mph, 7 mph, 12 mph, 20 mph, and 25 mph. First the test was performed without a guard and then the propeller was covered with a cage guard and, finally, with a ring guard. [Snyder, 1980] Snyder found that at 7 mph, the sausage was dragged off; at 12 mph, the sausage buckled, the skin split and was severed; at 20 mph, the sausage was severed, "whether struck by the strut, the skeg, the wires of the cage guard or the ring on the ring guard."[25] [Snyder, 1980] In a letter to the U.S. Coast Guard detailing these results, Snyder concluded that "cages around propellers have a place, but it is strictly in low speed, below 10 mph applications . . . " Likening propeller guards or water jet propulsion to surrounding cars with a "giant, ground hugging, soft cushion" or with requiring cages for airplane props, he commented that "all of these ideas would save lives but would be utterly impractical, very expensive, and quite unpopular." [Snyder, 1980]

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[25] The "strut" is the bracket supporting a ship's propeller. [Noel, 1988] The "skeg" is a protecting part that projects below the propeller of an outboard motor.

Lawrence Thibault Head Impact Tests

In a series of tests intended for attorney use in litigation, Lawrence Thibault, a University of Pennsylvania biomechanical engineer, analyzed the potential protective effect of a shroud or duct-shaped propeller guard. He initially determined that most victims of propeller injuries are struck by the blades from the side, relative to the forward motion of the boat, so a ring-shaped guard could prevent most contact with the propeller.[26]

Recognizing that strikes to the head are the most devastating of propeller injuries, Thibault struck the leading edge of the propeller guard against an instrumented Part 572[27] dummy head form (used routinely for automobile crash testing) to measure the forces sustained. The impact speeds ranged from 10 to 28 mph. He also tested a series of metal specimens described as "candidates for a crushable leading edge on such a shroud/duct design." Thibault concluded that "the results of this testing clearly demonstrate that the propeller guard can substantially

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[26] This conclusion is bolstered by the hydrodynamic analyses of other experts. For example, Hill and Reed both reasoned that the lower end and skeg of a boat operate to inhibit frontal contact with the propeller for nearly all persons in the water. In addition, the outflow from the propeller against a body in the water and the forward progress of the boat away from that body make contact with the rear of the propeller unlikely. This forward motion of the boat also tends to push surrounding water to the side and would increase the potential for contact with the propeller from the side rather than from the front or back. [Hill, 1987; Reed, 1987]

[27] The characteristics of this instrumented dummy are specified as part of the federal motor vehicle safety standards at 49 C.F.R. 572 (1991).

reduce or eliminate injury over the range of impact speeds. The results further demonstrate what has been known by the transportation industry for decades and that is the efficacy of energy management systems with regard to structural design and impact injury prevention." [Thibault, 1987]

Ben Hogan Diver Tests

In 1988, Alabama attorney R. Ben Hogan commissioned a test, supervised by Thibault, to determine if a guard alone would produce injuries, as Snyder and others had suggested. [Snyder, 1980] The test, which is unique in using a human subject, called for a stunt diver to be struck by boats equipped with Chadwell cage-type propeller guards. The trials employed a pontoon boat driven by an 88 hp Johnson engine manufactured by OMC and fishing boat equipped with a 90 hp Tohatsu engine. The surface of the propeller guard was coated with colored dye in order to confirm that the divers did in fact contact the guard and to indicate where the contacts occurred. Thibault had testified in court cases that it would take speeds of 18 to 20 mph to break human bone [Beech, 1989], so the tests were planned for lesser speeds. At speeds up to 12 mph, the diver struck by the propeller guard (as evidenced by the dye marker on his wet suit) sustained no injuries, neither lacerative nor blunt. The guards were not tested at speeds greater than 12 mph. [Hogan, 1989(b)]

University of Tennessee Cadaver Tests

In an effort to refine their investigation into the potential for injury from contact with a propeller guard, in 1990 Mercury Marine and OMC contracted with researchers at the University of Tennessee to conduct tests "to determine the effectiveness of a particular boat motor cage-type propeller guard as a safety device to protect a swimmer's leg." [Kress, 1991] The test protocol called for seven embalmed human cadaver legs to be struck at various speeds by a motor boat engine equipped with a cage-type propeller guard. The researchers sought to determine the threshold speed above which an impact sustained by human legs would result in complete loss of limb function.

Propeller Guard Feasibility Issues

1. Hydrodynamic Performance
   - Boat handling
   - Visibility
   - Top speed
   - Fuel efficiency
   - Guard durability
   - Acceptable performance trade-offs
2. Protective Effect
   - Variety of injury scenarios
   - Maximum boat speed at which a guard will protect people
   - Lacerative versus blunt trauma
   - Potential for limb entrapment
   - Increased underwater area with guard
3. Coast and Consumer Acceptance
   - Reduce need for replacement propellers
   - Marketing surveys not yet conducted
   - Potential for consumer removal of guard

The cadaver legs were sectioned at mid-thigh and attached to a dummy torso. They were then held horizontally below the water line of a test tank and struck by a propeller guard engine at speeds of 21 mph, 17.2 mph, 13.6 mph and 10.4 mph. In order to assess the level of injury sustained, the legs were X-rayed and dissected. The leg struck at 10.4 mph sustained a transverse fracture from which, the researchers judged, a full recovery would be likely. The legs struck at speeds greater than 10.4 mph sustained comminuted fractures which the researchers judged serious enough to result in loss of leg function. No objective criteria for the determination of probable limb function were specified; furthermore, no "blinded" evaluation of the X-rays was performed by outside experts unaware of the study's purpose.

None of the cadaver legs sustained extensive soft tissue or neurologic damage. Most of the cadavers, however, had been embalmed for several years prior to their use in this study, causing the tissue surrounding the bone to become more resistant to damage. The average cortex thickness of the embalmed legs was determined by the researchers to be comparable to that of a group of "fresher" embalmed legs, leading them to the conclusion

that bone strength was not adversely affected by the long-term storage of the test legs. No discussion, however, of the effect that relatively rigid soft tissue might have on more direct transfer of impact energy to the bone was reported.

The average age of the cadavers used was 75 years. This is noteworthy because the likelihood of fracture, given the same force, increases dramatically with age, due to osteoporosis and other changes in bone composition that begin at about age 45 and accelerate thereafter. [Consensus Conference, 1984]

The authors concluded that for their specific test conditions, the "prop-guard cage is not an effective device in preventing severe leg injury at boat velocities greater than or equal to about 13 mph", [Kress, 1991] but they acknowledged that "it would be desirable for future tests to utilize a cadaver population that is somewhat younger to relate better to real-life situations" and that "additional tests are needed to provide a statistically justifiable technical basis" for their results. [Kress, 1991]

Conclusion

The question of the hydrodynamic feasibility and protective effect of propeller guards continues to be debated as new information is developed. Although there is little agreement about the hydrodynamic feasibility of guards, there does appear to be some consensus that a cage-type guard would prevent most serious limb injuries

at impact speeds at least up to 10 to 12 mph. [Thibault, 1987; Hogan, 1989; Kress, 1990][28]

Unfortunately, both opponents and proponents of guards have primarily developed this information in the context of personal injury litigation. There is a need for additional non-litigation-related research by government and academic or other independent institutions to develop interventions intended to prevent propeller injuries. In addition, marine propulsion manufacturers, who profit from the sale of marine engines, have the obligation and the resources to appropriately investigate ways to prevent or ameliorate the injuries their products cause.

Part Three

Propeller Injury Policies, Legislation and Litigation

Introduction

As with efforts to prevent other product-related injuries, propeller injuries and the feasibility of guarding technology have been addressed in a number of different forums. These potential avenues to reduce or eliminate

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[28] But see discussion accompanying Snyder "sausage test" (suggesting the potential for serious injury at lower speeds) [Snyder, 1980] and discussion accompanying Thibault head impact tests (suggesting that guards can prevent fatal head injuries at much higher speeds). [Thibault, 1987]. Donald Huelke of the University of Michigan has also reported that in tests he conducted for OMC several years ago, test dummies sustained presumably fatal head injuries in some trials conducted at speeds below 10 mph. Test protocols and results were not available. [Huelke, 1992]

propeller injuries have included federal or state government rulemaking to mandate propeller guards, voluntary manufacturer provision of guards as original equipment and personal injury litigation designed to compensate victims of unguarded propellers while providing manufacturers a monetary incentive to make their products safer.

Unfortunately these efforts have not successfully met the propeller injury problem. Despite a decade-long series of internal analyses, the federal government has refused to require propeller guards, and state initiatives to combat propeller injuries remain at a preliminary level. Outboard motor manufacturers have failed to provide guards, choosing instead to defend this position in court. Litigation has not forced manufacturers to change their position, as OMC and Mercury Marine have prevailed in the majority of these lawsuits.

United States Coast Guard

In the United States, the Coast Guard is responsible for monitoring and providing statistical reports of recreational boating injuries. In addition, the Coast Guard has been delegated authority under the Federal Boat Safety Act of 1971 to prescribe regulations "requiring the installation, carrying, or use of associated equipment . . . on recreational vessels subject to this chapter, and prohibiting the installation, carrying or use of associated equipment that does not conform with safety standards established under this section." [46 U.S.C.A. 4302(a)(2) (West Sp.Pamph. 1991)] Therefore, if the Coast Guard were to conclude that propeller guards are needed to

mitigate a serious boating hazard, it has the authority to require them.[29]

To date, the Coast guard has not promulgated any regulations requiring propeller guards, nor is any rulemaking in progress. Since the late 1970s, however, the Coast Guard has conducted several analyses of the incidence, severity and potential for prevention of propeller injuries.

In 1979, Coast Guard statistician Ken Freund analyzed all propeller injury incidents coded in 1978 as "struck by boat or propeller." [Freund, 1979] Freund looked at variables such as operator age and experience, speed, and direction of impact in order to examine the effectiveness of several proposed means of eliminating or reducing propeller injuries. After determining that start-in-gear protection[30] would have prevented none of the 52 fatalities and only 3 of the 171 injuries he had identified, Freud concluded that "the verdict on propeller guards is just the opposite. It is projected that 39 of the fatalities [75

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[29] Before promulgating any regulations under the Act, the Coast Guard is required to consult with the National Boating Safety Advisory council (NBSAC) [46 U.S.C.A. § 4302(c) (West Sp. Pamph. 1991)], whose 21 members are appointed by the Secretary of Transportation. The Act requires that council membership consist of seven state boating safety officials, seven representatives of recreational vessel or associated equipment manufacturers, and seven representatives of the general public (at least five of whom must be members of national recreational boating organizations). [46 U.S.C. § 13110]

[30] "Start-in-gear" protection prevents the propeller blades from spinning when an outboard motor is first started by keeping the engine in "neutral" rather than "in gear."

percent] could have been prevented, 67 of the injuries could have been prevented and 93 others could have been less severe [total 94 percent]," using a cage-type propeller guard. [Freund, 1979] He also stated that "for the propeller guard approach, benefits would have to be measured for each design type, and the extent of adverse impact on boat performance assessed." Finally, Freund recommended that "in-house or outside research and development be initiated to develop potential solutions to propeller accidents . . . [T]he magnitude of this problem requires immediate attention and action." [Freund, 1979]

In a November 20, 1979 internal memo, A.J. Marmo of the Coast Guard's Policy Planning and Information Analysis Staff attempted to limit the scope of several of Freund's conclusions regarding propeller guards. He stressed the subjective character of Freund's determination that a propeller guard would have prevented an injury or fatality; in fact, he argued that in some cases the probability that an injury would have been prevented might have been as low as 25 percent. Marmo also explained that the propeller guard was assumed to have no sharp edges and would have included a rubber covering surrounding the metal network. The memo does not describe any proposed follow-up to Freund's report or pending action on its recommendations.

In 1984, statistician Gary Traub conducted another Coast Guard analysis of its propeller injury data (this time using 1983 boating accident reports). Although Traub found that the estimates of the ability of propeller guards to prevent injuries and fatalities had fallen slightly since Freund's 1979 study, he concluded that "the percentage of victims who would be helped by the guard

is still very high at eighty-six percent." [Traub, 1984] This represented 30 of 33 injuries and 6 of 9 fatalities whose adverse outcome would have been eliminated or made less severe. Again, as with the Freund report, there is no evidence in the Traub study or elsewhere of a meaningful Coast Guard response to this information.

In March 1987, Edward Purcell and Walter Lincoln, with the U.S. Coast Guard Research and Development Center, submitted a report entitled "Boat and Propeller Impact Injuries and Fatalities." The report is described as completing a Coast Guard project, begun in 1985, intended to define the extent of the propeller injury problem and to evaluate available countermeasures. The authors recognized that propeller guards were being used in certain low speed applications, but noted that "their use on higher speed craft raises questions of efficiency and comparative safety." [Purcell, 1987]

Purcell and Lincoln concluded that existing data did not allow an accurate determination of the true magnitude of the propeller injury problem. They recommended a systematic analysis of propeller injuries and countermeasures, including: 1) active data collection via a random hospital sample; 2) biomechanical analysis of the effects of underwater impact on human tissue, considering variations in body tissue, blade tip speed, and impact angle; 3) a program to encourage private sector development and refinement of countermeasures; and 4) use of the biomechanical and mechanical data to rate the protective effect of the various proffered countermeasures. [Purcell, 1987]

The official Coast Guard response to the Purcell and Lincoln report stated that "inadequacy of existing data does not justify immediate attention to evaluation of alternative design concepts with the intent of identifying engineering solutions. Higher quality data must be collected to define the extent of the problem. Future analysis of an improved accident data base may justify later initiation of a safety device development program." In addition, the Coast Guard returned to its emphasis on boating safety education, concluding that "[p]resent Coast Guard efforts may be better expended on safety education rather than device development." [Powell, 1987]

Thus, Freund and Traub recognized the incompleteness of existing propeller injury data but concluded that they were nevertheless sufficient to justify the need for propeller guards. Purcell and Lincoln, however, reasoned that no conclusions could be drawn until adequate data had been collected and urged a program of active data collection. The Coast Guard did not effectively implement either set of recommendations.

In May 1988, nearly ten years after the preparation of Freund's propeller injury report, the U.S. Coast Guard asked the National Boating Safety Advisory Committee (NBSAC)[31] to form a subcommittee to examine the issue of propeller injuries and the feasibility of propeller guarding. The subcommittee was instructed to assess the magnitude of the problem and the feasiblity of and need for propeller guards. It had in its possession much of the

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[31] See note 29, supra.

material described in this monograph (produced prior to release of its report).

On November 7, 1989, the propeller guard subcommittee issued its report, recommending that no regulatory action be taken to require propeller guards. The subcommittee listed a number of reasons for its decision; but it is difficult to analyze the subcommittee's rationale since it did not cite the specific sources for many of its conclusions and no official meeting transcripts were prepared.

The subcommittee recognized the incompleteness of existing data for propeller injuries (repeating the Coast Guard's usual estimate of only five to ten percent reporting of non-fatal injuries), but asserted that "available sources can be utilized collectively to give an accurate portrayal of the significance, frequently, and relative magnitude of underwater impacts to other causes of boating accidents in particular and accidents in general." [NBSAC propeller guard subcommittee, 1989] The subcommittee apparently relied heavily upon information presented to it by Robert Taylor of Failure Analysis Associates (a consulting firm which has performed work on behalf of manufacturers in product-related injury litigation). Taylor compared fatalities per million exposure hours for various activities and found that recreational boating ranked near the bottom of the list (with "struck by boat or propeller" fatalities constituting only about five percent of the 1976-1981 recreational boating fatality total). Taylor's propeller fatality data apparently were derived primarily from the Coast Guard's existing data

set;[32] the source of his 1981 exposure data is not specified. Taylor also presented non-fatal propeller injury data [Taylor, 1992], but these were not specifically discussed by the subcommittee in its report. [NBSAC propeller guard subcommittee, 1989]

Among its recommendations, the subcommittee urged the Coast Guard to improve its accident reporting and analysis to "develop a complete and comprehensive data base on underwater impact accidents." Conversely, without discussing the information available in the Coast Guard's own analyses prepared by Freund, Traub and Purcell, or the information contained in the medical literature, such as Price and Moorefield's 1987 study[33], the subcommittee concluded, "[T]here is no indication that any change in reporting would reflect significant changes in the relative position or percentage of injuries/fatalities due to underwater impacts. Therefore, propeller guarding . . . could have only a negligible impact on improving boating safety." [NBSAC propeller guard subcommittee, 1989]

On the subject of the hydrodynamic performance of propeller guards, the subcommittee report stated that guards in current design would unacceptably decrease the top speed and correspondingly increase fuel consumption on boats so equipped. [NBSAC propeller guard subcommittee, 1989] Apparently the subcommittee based this conclusion, at least in part, on information presented in an oral report by "an engineer for one of the engine

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[32] See pages 3-12, supra.

[33] See Part One, page 11, supra.

manufacturers" (the specifics of the description and the list of presenters suggests that the source of this information was Richard Snyder of Mercury Marine). [NBSAC propeller guard subcommittee, 1989] The reports prepared by Taggart, Reed and Hill[34] suggesting improved handling characteristics with minimal speed and fuel economy diminishment were in the subcommittee's possession, but the data and conclusions contained in these reports were not discussed, beyond merely noting that proponents of guards believe them to be hydrodynamically acceptable in current or anticipated design. The report also did not describe what, in the subcommittee's view, might constitute acceptable diminishment of speed or fuel economy in exchange for human protection. The OMC propeller guard patent and reports related to OMC projects 441 and 443 apparently never were furnished to the subcommittee. (They do not appear among the list of materials reviewed by the subcommittee.)

In addition, the subcommittee concluded that a ring-shaped guard would not provide adequate protection against impacts from the front or back and could result in limb entrapment. [NBSAC propeller guard subcommittee, 1989]. A cage-type guard (reducing or eliminating the risk of entrapment) would not offer substantial protection above 10 mph, the subcommittee determined. Contact with any propeller guard at speeds above 10 mph, it reported, would replace laceration injuries with devastating, possibly fatal, blunt trauma. Blunt contact with an underwater appendage, the subcommittee said, produces more serious injury than the "series of evenly spaced cuts

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[34] See pages 17, 20-21, supra.

which are relatively easier to repair surgically" associated with unguarded propeller blades. [NBSAC propeller guard subcommittee, 1989]. Again, the data supporting these conclusions, rather than the contrary information described in the medical literature[35] (detailing the devastating character of many propeller injuries) and in the reports prepared by Thibault and Hogan[36] (examining the protective effect of guards at higher speeds), are not adequately presented.

The subcommittee also expressed concern that use of a propeller guard would increase the likelihood of underwater contact by "substantially" increasing the underwater profile of the engine. The report notes that "opponents [of guards] have stressed that the frontal impact area would be increased by three times by attaching the guard." The supporting data for this calculation are not included, and tested guard configurations have shown it to be inaccurate.

In its ultimate decision not to recommend propeller guards, the subcommittee appears to have adopted the conclusion that "the objective of simultaneously protecting the propeller from damage, protecting personnel [in the water] and making no material sacrifice of speed involve[s] irreconcilable physical laws and an insoluble manufacturing dilemma." [NBSAC propeller guard subcommittee, 1989] Underlying this conclusion is the subcommittee's assumption that "by definition, a guard must both diminish a hazard and leave the object capable of

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[35] See pages 2-3, supra.

[36] See pages 22-23, supra.

normal function, at a cost which is reasonable in proportion to the extent of the hazard. . . . Above all, it is fundamental that a guard should not create a condition which leads to a new or worse hazard." [NBSAC propeller guard subcommittee, 1989]

Certainly no safety device is acceptable if it causes *more severe* injuries than those it eliminates. However, the subcommittee's view that a safety guard must create no *new* hazards needlessly excludes propeller guards or any safety device which can prevent serious injuries while perhaps creating lesser ones. The lap-shoulder belt system in automobiles provides a good model for this sort of beneficial trade-off. In exchange for preventing ejections and reducing the risk of violent, injurious contact with the car's interior structure, lap-shoulder belt wearers may suffer abrasions, contusions or other minor to moderate injuries as a result of being restrained by the belt. While lap-shoulder belts can create these new, lesser injuries, they are critically important in preventing far more serious, even fatal, injuries.

On February 1, 1990, the Coast Guard, relying upon the subcommittee's recommendation, decided not to require propeller guards. [Nelson, 1990]

The propeller injury issue, however, has not been definitively settled by the subcommittee's recommendation. At the urging of consumer advocacy groups, as part of the 1991 Department of Transportation appropriations bill, Congress allocated $150,000 to the Coast Guard to develop improved data for the incidence and severity of propeller injuries. That effort is being conducted under the aegis of the Centers for Disease Control, with the first

report expected in 1992. [House Rep. No. 584 101st Cong. 2d Sess. 37 (1990)].

In the meantime, the Coast Guard annual report continues to aggregate propeller injuries in the "struck by boat or propeller" category and to report accident types by the first event in any accident scenario. The Coast Guard has proposed no changes in its data collection or reporting methods, nor is it currently conducting any additional activities specifically addressing propeller injuries or guards.

Manufacturers

In the United States, OMC and Mercury Marine together dominate the recreational boating propulsion market. In 1988, OMC reported net earnings of more than $70 million, while Mercury Marine earned more than $280 million. [OMC, 1989; Brunswick, 1989] Neither company has invested its vast resources in a committed and well-funded research and development plan to monitor the deaths and injuries its engines cause, or to design and test effective countermeasures.[37] By contrast, during a recent propeller injury trial, Don Kueny, the chief engineer for outboard design at OMC, described his company's efforts to design a single 150 hp V-6 engine. OMC committed the talents of five engineers (presumably with considerable support staff) for approximately three years

[37] In fact, much of the manufacturer propeller guard testing has been "litigation testing" in an effort to assess privately manufactured guards, rather than true research and development work intended to design improved guards.

with a budget of $2-3 million. When asked, "[H]as OMC ever had a research and development program to try to develop a propeller guard to protect people?" Kueny responded, "The answer is 'no.' " [*Elliott*, 1989] Given this failure, it is not surprising that neither company offers for sale (as standard or optional equipment) a propeller guard intended to protect people in the water.[38] In fact, no marine engine manufacturer[39] has ever marketed such a propeller guard.[40]

Several possible explanations for engine manufacturers' refusal to invest in the development of propeller guard technology have been advanced. Richard Snyder, principal engineer for product evaluation at Mercury Marine, has testified in court and argued to the Coast Guard that "the industry believed there was a universal understanding that marine propellers were open and obvious dangers not even requiring warnings. Further, the industry thought it was universally accepted that any guarding dervice set in motion against the object trying to be protected no longer could be considered a guarding device." [Snyder, 1988] Snyder asserted that a propeller guard design which did not unduly affect the hydrodynamic characteristics of the boat and also protected

[38] OMC does sell a guard designed for boats operating at 15 mph or less in order to protect the propeller from damage.

[39] Volvo Penta, a Swedish manufacturer, has begun a limited project to develop a propeller guard which would protect people, but none has yet been offered for sale.

[40] Although several private companies have offered guards as after-market accessories, some engine manufacturers have taken the position that engine warranties may be in jeopardy if such devices are installed.

persons in the water would "defy physics." [Snyder, 1988]

It has also been argued that if good propeller guards could be designed and were provided as original equipment with a marine engine, consumers would simply remove the guards, resulting in a dangerously overpowered boat. This argument is difficult to evaluate since manufacturers have not yet provided an original equipment guard, nor have they sought engineering or educational solutions to this potential problem.

Since propeller guards to protect people in the water would offer at least some protection against propeller damage caused by underwater objects, some plaintiff's attorneys have argued that manufacturers' failure to develop and market propeller guards stems partly from a desire to protect their lucrative market for replacement propellers. For example, documents produced pursuant to litigation suggest that in 1989 OMC sold approximately 50 propellers for every engine it manufactured. [OMC, 1990] On the other hand, Snyder has reported that Mercury sells only 1.6 propellers for every new engine and argued that if propeller guards were feasible, they would themselves be a lucrative source of revenue for a manufacturer. [Snyder, 1988]

It may also be that manufacturers view boat speed as a marketing tool threatened by propeller guards. Certainly, boat and engine advertisements frequently employ speed as a selling tactic. Any device which reduces the top speed of a boat, it might be argued, is contrary to that image of power fostered by engine manufacturers and is

potentially bad for business. The validity of this argument is also difficult to assess; the author could find no manufacturer discussion of what might represent acceptable reduction of speed in exchange for human protection.

Finally, the potential liability facing engine manufacturers should they acknowledge the feasibility of propeller guards may also be a motivating factor.

Litigation

Given the Coast Guard's refusal thus far to mandate propeller guards and the marine engine manufacturers' unwillingness to introduce them voluntarily, the primary forum in which issues of propeller guard feasibility and desirability are addressed has become the courts. Since the 1970s, more than three dozen lawsuits have been filed against marine engine manufacturers, seeking compensation for injuries allegedly caused by unguarded propellers. [Hogan, 1989(a)] Little of the information presented during these legal proceedings is readily available, however, for several reasons. Some of the lawsuits have been settled out of court for undisclosed amounts of money. Others are trial level decisions for which there is no written judicial opinion, so that any information may be limited to the prevailing litigant's descriptions or to the trial transcripts.

Several cases for which some information is available will be briefly summarized here to illustrate the character of the arguments presented as well as the potential for personal injury litigation as a means to prevent future propeller injuries.

Fitzpatrick v. Outboard Marine Corporation

On August 10, 1980, 16-year-old Kevin Fitzpatrick and his 17-year-old sister, Lisa, were playing in the water at Patcong Creek Cove near Ocean City, New Jersey. While swimming approximately 15 to 20 feet from shore, Kevin was struck in the head by the propeller of a 70 horsepower Evinrude engine (made by OMC) powering a Boston Whaler boat travelling at approximately 20 to 30 mph. Later that day, Fitzpatrick was pronounced dead at Shore Memorial Hospital, having suffered massive head trauma and loss of blood. [Bolden, 1985]

In July 1982, Fitzpatrick's family brought suit in Pennsylvania state court against the operator of the boat for his negligent conduct and against OMC for its failure to provide a propeller guard to prevent or reduce the injuries which Kevin had sustained. [*Fitzpatrick v. OMC*, No. 82-9635 (Ct of Common Pleas, Delaware County, PA, January 28, 1985)] After settling with the boat operator, trial began in January 1985 against OMC.

The case against OMC was based on theories of negligence and strict liability. At trial, the plaintiff was required to prove that propeller guards were feasible at a reasonable cost and that a guard would have saved Kevin Fitzpatrick's life. Plaintiff presented evidence of the feasibility and protective effect of guards, relying principally upon the analyses of Robert Taggart and Lawrence Thibault.[41] Taggart testified at trial that propeller guards had been technologically feasible for many years prior to

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[41] See pages 17-18, 22, supra.

Fitzpatrick's injury. Thibault presented the results of his propeller guard head impact testing and asserted that, had a guard been provided by OMC for its engine, Fitzpatrick would have survived the impact, likely sustaining a scalp laceration, skull fracture and concussion.

After its deliberations, the jury found that OMC was negligent and that its product was defectively designed. They established damages of approximately $1.1 million, with 60 percent of the total liability apportioned to OMC and the remainder to the operator of the boat. [Bolden, 1985]

OMC has appealed the verdict. Post-trial motions were decided in Fitzpatrick's favor by the court and the appellate court decision is expected in 1992.

Elliott v. Mercury Marine

On the night of July 24, 1982, 14-year-old Ashley Elliott was celebrating her initiation into the "Subdeb" social club at school by taking a midnight dip with several girl friends in the Tennessee River near Sheffield, Alabama. Several young men watching the initiation ceremony from a nearby boat decided to join the group. One of the boys maneuvered his Sport-Craft boat equipped with a 165-hp Mercruiser engine close to the girls. As the boat swept through the water where Elliott was swimming, the propeller slashed her right leg and buttock, severing nerves. Elliott was rendered functionally impaired and disfigured, despite numerous surgeries. [*Elliott*, 1989]

Elliott filed suit against both Mercury Marine and Sport-Craft. In the first trial, begun August 16, 1988, in federal district court in Birmingham, Alabama, a mistrial was declared when the jury was unable to reach a verdict. In the retrial, begun January 9, 1989, Sport-Craft was released as a defendant and the focus was tightened on Mercury Marine since, as a Sport-Craft representative had testified (and as Mercury recognized), boat builders have relied on engine manufacturers for expertise in propeller guarding. [Hogan, 1989a]

The primary factual issues at trial were the hydrodynamic acceptability and protective effect of propeller guards. The trial pitted manufacturers and their battery of experts against what Elliott's attorneys presented as a feasible guard design, exemplified by the Chadwell guard.[42] Prior to trial, Brian Chadwell had placed a prototype of his guard on the boat involved in Elliott's accident and performed speed and handling tests. These were shown to the jury on film, along with demonstrations of the guarded boat pulling two water skiers and of defense attorneys and experts operating the boat. Under questioning, experts for the plaintiff admitted that the Chadwell guards were only a first step, albeit an important one, in the development of a refined propeller guard, but testified that Mercury had all the information it needed to develop guards appropriate for pleasure boats. According to testimony by Arthur Reed, a naval architect and marine engineer who authored a 1987 study on

[42] See page 20-21, supra.

guards,[43] it would have required an investment by Mercury Marine of only $1.5 million to make feasible guard designs ready for the marketplace.

Mercury Marine did not contest that a Chadwell-type ring guard could have been manufactured 15 years earlier. They did argue that the Chadwell guard was not hydrodynamically acceptable and did not offer superior protection to an unguarded propeller. Mercury's experts, led by Richard Snyder, additionally testified that they had never seen a feasible design; Snyder doubted that there would ever be a consumer market for the devices, due to the (in his view) inevitably decreased top speed, reduced fuel efficiency, and impaired handling of the boat with a propeller guard.[44] [*Elliott*, 1989] Testimony and evidence presented at trial, however, revealed that no marketing and little research had been done to design, develop or ascertain potential consumer acceptance of a propeller guard intended to protect people in the water. [*Elliott*, 1989]

As to the ability of a propeller guard to offer protection, Mercury argued that the addition of a propeller guard, by substantially increasing the underwater profile of the boat/engine combination, enhanced the risk of being struck, and that getting hit by a propeller guard might cause injuries more severe than those associated with an unguarded propeller. Plaintiff's witness, Lawrence Thibault, presented his dummy head impact tests,

[43] See pages 20-21, supra.

[44] In fact, Snyder testified that "safety" is one reason that Mercury does not market propeller guards.

demonstrating the survivable nature of even relatively high speed contact with a propeller guard. After reviewing Alabama marine accident reports, he also testified that 80 to 90 percent of the propeller injury incidents in Alabama could have been mitigated had a ring guard like Brian Chadwell's been used. [Hogan, 1989]

The jury's deliberation in the *Elliott* case centered on Mercury's failure to conduct the necessary research and development to design a feasible propeller guard. "If propeller guards were feasible, then Mercury was at least negligent, if not grossly negligent, in failing to conduct research and development on them and place them on their products for the past 15 years," argued Elliott's attorney, Ben Hogan. After seven trial days, the jury reached a decision, awarding Elliott $1.5 million in compensatory damages and $3 million in punitive damages, apparently figuring two times the $1.5 million Reed had estimated it would take to make guard designs ready for manufacture. [Hogan, 1989(a)] Mercury immediately appealed the decision.

On June 25, 1990, the U.S. Court of Appeals for the Eleventh Circuit reversed the district court's decision and set aside the jury verdict, *Elliot* [sic] *v. Brunswick Corporation*, 903 F.2d 1505 (11th Cir. 1990).[45] Applying the Alabama Extended Manufacturers Liability Doctrine

[45] Federal jurisdiction for the *Elliott* case was based upon the diversity of citizenship of the adverse parties. When a federal court hears a case under its diversity jurisdiction, it must apply the law of the forum state, here Alabama. Recognizing that the highest court within the state of Alabama had not yet had an opportunity to address the precise issues raised by the *Elliott* case, the Court of Appeals looked to the

(AEMLD) to the facts of the *Elliott* case (as had the trial court), the appellate court determined that the plaintiff must prove that an unguarded propeller was defective in that it "does not meet the reasonable expectations of an ordinary consumer as to its safety." [903 F.2d 1505, 1507 quoting *Casrell v. Altec Industries, Inc.*, 335 So.2d 128, 133 (Ala. 1976)] Further, it held that the plaintiff must demonstrate that a "safer, practical, alternative design was available to the manufacturer at the time it manufactured the [product]." [903 F.2d 1505, 1507 quoting *General Motors Corp. v. Edwards*, 482 So.2d 1176, 1191 (Ala. 1976)]

The trial court in *Elliott* had determined that whether an unguarded propeller met the "consumer expectation" test for the existence of a defect was appropriately a question for the jury to answer (as are most factual questions, after the plaintiff has met an initial burden of coming forward with some evidence). The reviewing court held, however, that the trial court had erred in allowing the jury to make this determination. Where the involved parties "contemplated the nature of the defect at the time of the accident," the court (not the jury) should assess the plaintiff's allegations that a product is defective. [903 F.2d at 1507] Comparing boat propellers to knives, saws and fishhooks, the appellate court concluded that, as a matter of law, "the dangers inherent in Mercury's product should have been apparent to, or within the contemplation of Elliott," so that the

body of Alabama law in an effort to match its own ruling with what it believed the Alabama Supreme Court would conclude.

unguarded propeller was not defective within its interpretation of Alabama law.[46]

Although this determination alone would have been enough to reverse the lower court decision, the appellate court went on to analyze the evidence for the availability of a safer alternative design, the second element of plaintiff's case. When an appellate court is asked to set aside a jury's factual conclusions, the standard of review generally requires the reviewing court to determine that no reasonable jury could have reached the conclusions at issue. The court must avoid merely substituting its judgment for the judgment of the jury, which had the opportunity to hear the witnesses' live testimony and assess their credibility in person. In *Elliott*, the Court of Appeals determined that the plaintiff's evidence of current propeller guard designs and its expert testimony that Mercury could have developed a marketable propeller guard through the commitment of appropriate research and development resources did not demonstrate the existence of a safer alternative design. [903 F.2d at 1509] It discussed the evidence presented on both sides and apparently determined that a reasonable jury could not have found Elliott to have met her burden (although the court's opinion does not state this explicitly and reads more like a *de novo* review by the court of the trial evidence).

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[46] Of course, from a more practical perspective, even if Ashley Elliott herself "contemplated" the "defective" nature of the unguarded propeller, there was little she could have done to avoid her injuries.

On May 3, 1991, the Supreme Court of Alabama confirmed the Court of Appeals' reading of Alabama law in *Beech v. Outboard Marine Corporation*, 584 So.2d 447 (Ala. 1991). Again interpreting the AEMLD, the court affirmed a summary judgment by holding that an unguarded propeller was not dangerous beyond the expectations of an ordinary consumer. Further, the court agreed that a safety device which arguably creates other dangers is not a "safer alternative design" within the meaning of Alabama products liability law. Where the plaintiff's allegation is only that the defendant *could* have developed a safer alternative design, the court held that a *prima facie* case is not established under the AEMLD.[47]

Preemption Cases

A pair of recent cases may present an even more disturbing set of legal obstacles for courtroom advocates of propeller guards. On August 7, 1988, Scott Mowery was riding in an inflatable raft on Lake Erie when he was struck by the propeller of a Mercruiser engine powering a Delta Sport DC 215 boat. Mowery was seriously injured and on July 10, 1990 commenced a products liability action against Mercury Marine for its failure to provide a propeller guard. (He also sued Larson Boats, the powerboat manufacturer.) Before any trial could begin, Mercury filed a motion to dismiss the lawsuit, arguing that the U.S. District Court in Ohio lacked subject matter jurisdiction because Mowery's claim was preempted by a federal law, the Federal Boat Safety Act of 1971 (FBSA). [46

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[47] See also, *Veal v. Teleflex Inc.*, 586 So.2d 188 (Ala. 1991).

U.S.C.A. 4301, *et seq.* (West Sp. Pamph. 1991)] Under the FBSA, Congress delegated its rulemaking authority in the area of recreational boating equipment safety standards to the Department of Transportation. The powers and duties conferred by the FBSA were subsequently delegated to the Coast Guard. The FBSA contains a "preemption clause" which prohibits a state from enacting any boating equipment safety standard not identical to the federal standard.[48] The Act also includes a "savings clause" which provides that compliance with any regulation promulgated under the FBSA will not relieve a manufacturer from liability at common law. [46 U.S.C.A. 4311(g) (West Sp. Pamph. 1991)] Mercury Marine asserted that the Coast Guard had considered the issue of propeller guards and found that no regulation should be promulgated under the FBSA. Mercury Marine argued that this represented a decision not to regulate in this specific area and carried the same preemptive force as a more affirmative safety standard.

In *Mowery v. Mercury Marine*, 773 F. Supp. 1012 (N.D. Ohio 1991), the court agreed. It held that Scott Mowery's claim was preempted by the FBSA and granted Mercury Marine's motion to dismiss the lawsuit. Citing the propeller guard subcommittee's report to the NBSAC and the Coast Guard's acquiescence in its recommendation not to regulate, the court determined that to allow the potential

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[48] The primary rationale for inclusion of a preemption clause in a statute such as the FBSA is to prevent the 50 states from enacting a patchwork of different regulations, making it difficult and inefficient for manufacturers to conform their products to so many varying standards.

imposition of damages under state common law would be "tantamount to recognition of a state requirement that [propeller guards] be installed – an act explicitly forbidden by the FBSA's preemption clause." [773 F. Supp. at 1016]

The court also held that the FBSA's "savings clause" would not allow Mowery's claim to go forward. It determined that the clause only applied to claims alleging a defect in a piece of safety equipment actually installed, whether or not it was mandated under the FBSA. Under this line of reasoning, a manufacturer could be held liable only if it chose to install a dangerous and defective propeller guard. But if manufacturers never provide propeller guards (and the Coast Guard does not mandate them), then no liability action predicated on the failure would ever be allowed to go forward. Obviously, this provides a strong disincentive for manufacturers to provide any safety device not specifically required by the Coast Guard.

Just two months later, a second federal district court employed the same reasoning as the *Mowery* court in *Shields v. Outboard Marine Corporation*, 776 F.Supp. 1579 (M.D. Ga. 1991). Plaintiff Sheila Shields was a passenger in a recreational boat in Florida. The boat hit an underwater object and Shields was thrown overboard. She was struck and injured by the boat engine's propeller, manufactured by OMC. As had Mercury Marine, OMC argued that Shield's claim was preempted by the Coast Guard's affirmative decision not to regulate under the Federal Boat Safety Act, and asked the court to dismiss the lawsuit. The court granted OMC's request, noting that the Coast Guard's action implied "a decision that this area is

best left unregulated, which has as much preemptive effect as a decision to regulate." [776 F.Supp. at 1581] The court was similarly unmoved by Shields' argument that the FBSA's savings clause preserved her case. As an alternative rationale for its decision to dismiss the case, the court (following the reasoning in Elliott) declared that as a matter of state law, an unguarded propeller was not defective.[49]

In a more encouraging recent decision for propeller guard advocates, on May 28, 1991, a third federal district court analyzed the preemption issue arising under the FBSA. In *Eggen v. Griffith, et al.*, Civ. No. B-C-89-31 (E.D. Ark. May 28, 1991) (order denying summary judgment), Jeffrey Eggen sued OMC for injuries sustained on August 13, 1986, when he fell from a Gator Pro 154 boat and was struck by the boat's unguarded 1984 50 horsepower Johnson outboard. Again, OMC asked the court to dismiss the lawsuit, arguing that it was preempted by the FBSA.

For a number of reasons, the court denied OMC's request. Before discussing any of the statutory or policy-based reasons for its ruling, the court noted that all critical factual aspects of the cause of action (the date of the injury, of the manufacture of the engine, and of the filing of the law suit) preceded the Coast Guard's February 1990 adoption of the NBSAC propeller guard subcommittee's recommendations. The court then reiterated "[t]he time honored rule that only regulations existing at the time the case of action accrued are applicable [to a

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[49] But see, *Calabro v. Outboard Marine Corporation*, 1992 Fla. App. Lexis 6081 (May 26, 1992) (rejecting defendant's "assumption of the risk" defense).

preemption analysis]." [*Eggen* at 8] It refused to violate this rule, and held that the Coast Guard's purported "regulation" could not be applied retroactively to preempt Eggen's case.

Perhaps more importantly, the court also concluded that Eggen's case was not preempted by the FBSA, even without relying upon its "retroactivity" analysis. At the outset, the court noted the traditional presumption against a finding of preemption absent clear evidence of a Congressional intent to limit the sort of state action being challenged (here, an award of civil damages). As a matter of statutory interpretation, the court held both that the Coast Guard's propeller guard "regulation" had no preemptive power and that Congress (through the FBSA) did not intend to preempt tort actions like Eggen's.

First, the court recognized that only a "*regulation* prescribed under section 4302" of the FBSA would have the power to preempt certain state actions. [*Eggen* at 12, emphasis original] Noting that §4302 of the FBSA contains strict guidelines for the promulgation of boating safety rules, the court held that the Coast Guard's decision not to require propeller guards was not a 4302 "regulation" and should be given no preemptive effect.[50]

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[50] Further emphasizing that only section 4302 regulation are to be given preemptive effect, the court also explained that Congress could have, but did not, append the FBSA's preemption clause to include the phrase "or agency inaction which is fundamentally equivalent to a section 4302 regulation." [*Eggen* at 12, 1991]

Reported Propeller Guard Litigation

1. *Fitzpatrick v. Outboard Marine Corporation*, No. 82-9635 (Ct of Common Pleas, Delaware County, PA, January 28, 1995). See also, Bolden, S., "Case Notes of Interest", February 1985 Philadelphia Trial Lawyers Association 3.

2. *Rose v. Mercury Marine, A Division of Brunswick Corp.*, 483 So. 2d. 1351 (Miss. 1986).

3. *Kunreuther v. Outboard Marine Corporation*, 715 F. Supp. 1304 (E.D. Pa. 1989), *modified*, 749 F. Supp. 658 (E.D. Pa. 1990).

4. *Elliott v. Brunswick*, CV 88-AR-1104-S (N.D. Ala. So. Div. Jan. 17, 1989) rev'd 903 F.2d 1505 (11th Cir. 1990).

5. *Shields v. Outboard Marine Corporation*, 776 F. Supp. 1579 (M.D. Ga. 1991).

6. *Eggen v. Griffith, et al.*, Civ. No. B-C-89-31 (E.D. Ark. May 28, 1991) (order denying summary judgment).

7. *Beech v. Outboard Marine Corporation*, 584 So.2d 447 (Ala. 1991).

8. *Mowery v. Mercury Marine*, 773 F. Supp. 1012 (N.D. Ohio 1991).

9. *Veal v. Teleflex, et al.*, 586 So. 2d 188 (Ala. 1991).

10. *Calabro v. Outboard Marine Corporation*, 1992 Fla. App. Lexis 6081 (May 26, 1992).

Next, the court again looked to the explicit language of the FBSA's preemption clause and determined that

"nowhere is there reference to common law or state law tort actions . . . " Given the general presumption against preemption (which it had previously noted), the court concluded that Congress had not intended the FBSA to preclude tort claims like Jeffrey Eggen's. [*Eggen* at 13]

Finally, the court held that, even if it accepted OMC's arguments that the Coast Guard's inaction constituted a "regulation" and that the FBSA's preemption clause was potentially applicable to state tort actions, the Act's savings clause would preserve Eggen's claim. Rejecting OMC's argument for an interpretation of the savings clause inconsistent with its plain language, the court asked, "What in the world is this savings clause intended to address if not an action such as this?" [*Eggen* at 14]

Personal injury litigation has for decades been an effective public health tool, providing an important incentive for manufacturers to design and build safer products. [Teret, 1986; Eads, 1983] Several recent trial and appellate court decisions regarding propeller guards, however, have refused to allow a jury to weigh the costs and benefits to society of unguarded propellers versus propeller guards. These decisions weaken manufacturer incentive to make propellers safer.

In 1932, Judge Learned Hand stated in the influential case, *The T.J. Hooper*, 60 F.2d 737, 740 (2d Cir. 1932), that "[a] whole calling may have unduly lagged in the adoption of new and available devices. It may never set its own test, however persuasive be its usages. Courts must in the end say what is required; there are precautions so imperative that even their universal disregard will not excuse their omission." A judicial determination that

unguarded propellers, as a matter of law, are not dangerous beyond the expectation of an ordinary consumer, however, implicitly violates the spirit of Judge Hand's decision. In many ways, a consumer's expectations about the safety of a product (and the feasibility of making it safer) are driven by the activities and information supplied by the manufacturer. If manufacturers do not provide propeller guards and do not warn users about dangers associated with unguarded propellers (alleged to be patent and obvious), they contribute greatly to the consumer's low expectations regarding the product.

Of course, preempting plaintiff's case entirely may have an even more chilling effect upon a manufacturer's incentive to make its products safer. Where that preemption is based upon government regulatory action or inaction, manufacturers may be strongly motivated to influence or control the very regulatory process which will subsequently insulate them from liability.

State Action

If the effectiveness of tort litigation as an impetus for manufacturers to provide propeller guards has been limited by recent decisions, then any legislative or regulatory action at the state or local level to encourage or require propeller guards may be especially valuable.

Representative Matthew O'Neill of the Missouri General Assembly recently sponsored a bill to require propeller guards for all propeller-driven recreational boats sold or operated in Missouri after January 1, 1993. [H.B. 1689, 86th Gen. Assem., 2d Reg. Sess., Missouri, 1992) The bill defines a propeller guard as including cage-type

guards (but not ring guards). Violation of the proposed law is criminalized as a class A misdemeanor, with repeat violations or those resulting in "serious personal injury or death" categorized as a class D felony. The bill provides various exceptions to the propeller guard requirements, including boats used for law enforcement, sanctioned racing, ferrying, or those engaged in interstate commerce[51] on the Missouri or Mississippi rivers. To date, the bill has not been reported out by the appropriate committee within the Missouri legislature.

State public health departments can also play a potentially important role in the enumeration and prevention of propeller injuries. The Institute of Medicine's[52] landmark 1988 report, *The Future of Public Health*, recommended that "every public health agency regularly and systematically collect, assemble, analyze, and make available information on the health of the community, including statistics on health status, community health needs, and epidemiologic and other studies of health problems." In the context of propeller injuries, this "assessment"

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[51] Excepting boats engaged in interstate commerce from the bill reduces the likelihood of an FBSA preemption problem.

[52] The Institute of Medicine "identifies concerns in medical care, research, and education and secures the services of members of appropriate professions to examine policy matters relating to public health." The Institute of Medicine is part of the Academy complex, consisting of the Institute of Medicine, the National Academy of Sciences, the National Academy of Engineering, and the National Research Council. [Academy complex, 1991]

function is especially important and, as the report recognized, "cannot be delegated." [Institute of Medicine, 1988]

A responsible public health department cannot adequately assess the importance of propeller injuries based on the Coast Guard's data, nor can it rely on the Coast Guard for an appropriate resolution of the regulatory issues. The Coast Guard based its decision not to require propeller guards on patently inadequate data. Among the many data limitations, the NBSAC's propeller guard subcommittee admitted that Coast Guard statistics probably represented only five to ten percent of the true number of non-fatal propeller injuries; yet it concluded that propeller injuries were not an important public health problem.

A public health department can fulfill its assessment obligation for product-related injuries, like those associated with marine propellers, in a number of different ways. In most states, the Department of Natural Resources (or its analog) collects reports of recreational boating injuries and forwards them to the Coast Guard. These data can serve as a useful first step to compare the rates of injury within the state to those reported by the Coast Guard in its *Boating Statistics* report. If this initial analysis suggests that propeller injuries may represent a significant source of death and disability within the state (for example, propeller injuries are a vastly more serious problem in Florida than in Wyoming), a more sophisticated additional assessment can be performed. This might involve surveillance of emergency departments or questionnaires to local emergency medicine physicians

and orthopedic surgeons. Once the data have been gathered, the need for effective advocacy can be considered.

Even if scarce resources and competing public health problems prevent the sort of detailed assessment which propeller injuries warrant (an assessment, we have argued, which is more properly the responsibility of both the Coast Guard and the manufacturers) some involvement by state and local public health departments can still play an important role. It can sensitize the public about the dangers associated with unguarded propellers and perhaps alter expectations about the "obviousness" of the hazard and about manufacturers' ability to make propellers safer.

Conclusion

Solutions to the public health problem of propeller injuries demand appropriate action in each of the major forums that have been discussed. Neither the Coast Guard nor marine engine manufacturers have undertaken reasonable measures, clearly within their power, to reduce or eliminate these often preventable deaths and injuries. Instead, the very regulatory process which should act to make outboard motors safer has helped to insulate manufacturers from a remaining force for change, by preempting some personal injury lawsuits.

Additional advocacy for interventions designed to reduce the incidence and severity of propeller injuries is needed. The Coast Guard and manufacturers should reverse their opposition to propeller guards and act to require or voluntarily provide them. Meanwhile, public

health professionals in state departments, in other government agencies and in academic institutions should understand the extent of the propeller injury problem and support efforts to increase public awareness as well as manufacturer and government accountability.

Part Four

Propeller Injury Misconceptions

A clear understanding of the importance of the propeller injury problem and of the proper means to address that problem has been hindered by a number of misconceptions. In many ways this misinformation parallels that which has obstructed progress in reducing other product-related injuries. In order to justify and undertake effective action to reduce the incidence and severity of propeller injuries, these misconceptions require critical examination.

Misconception: *Propeller injuries are not an important public health problem. They occur infrequently by comparison with other recreational boating injuries and do not merit increased attention, given limited government resources.*

Propeller injuries are systematically and substantially underreported by the U.S. Coast Guard, the federal agency charged with maintaining boating injury statistics in the United States. The true annual incidence of propeller injuries may be as much as 34 times that officially reported by the Coast Guard. [Red Cross, 1991; Freund, 1979] Without reliable data for the true incidence and severity of propeller injuries, the Coast Guard (and others) cannot make justifiable policy determinations regarding these injuries. In addition, even if a specific

injury production mechanism occurs less frequently than others within an agency's purview, this does not necessarily justify a failure to appropriately address that mechanism. This is especially true for propeller injuries, given their devastating character and the promising nature of various countermeasures.

Misconception: *Most propeller injuries are the result of operator error. Therefore, the most effective way to prevent these injuries is through improved training of boat operators and better enforcement of boating safety rules.*

The 1984 Coast Guard study of propeller strikes concluded that operator inexperience may have been a factor in some of the propeller injuries analyzed but that safety training was not. [Traub, 1984] Public health practice in injury control has demonstrated that the most effective means of preventing product-related injuries is to modify the product rather than attempting to alter the behavior of millions of consumers. For example, air bags or seat belts which make the passenger compartment of a vehicle less hostile have proved effective in preventing motor vehicle-related deaths and injuries, while driver training courses have not. [Robertson, 1992]

Misconception: *The "open and obvious" danger of marine propellers justifies a manufacturer's failure to safeguard its motorboat engines.*

Every manufacturer who places a product into the stream of commerce has an obligation to make that product as safe as reasonably possible, while still permitting it to function as intended. Car fans, meat grinders, window fans, and the propellers of air boats like those used in the

Everglades all have blades whose danger, generally visible to potential victims, is more "open and obvious" than the dangers of motorboat propellers, which are hidden underwater. Yet all customarily include guards intended to separate people from injurious contact with those blades. Further, the fact that "innocent bystanders" (for example, swimmers run over by powerboats) can be the victims of unguarded propellers should nullify any "open and obvious" argument.

Misconception: *No hydrodynamically acceptable propeller guard has been designed. Propeller guards are not an appropriate safety device because they will diminish the top speed, fuel economy and maneuverability of a recreational boat.*

Although propeller guards have been used successfully in relatively low speed applications by surf rescue agencies in several countries and by the military for some training craft, marine propulsion manufacturers have not committed substantial research and development money to designing and manufacturing hydrodynamically acceptable propeller guards. For example, Mercury Marine admitted that, since the early 1970s, it had conducted fewer than ten research projects to design and evaluate devices intended to prevent or ameliorate propeller injuries. By comparison, major automobile manufacturers commonly engage in a more extensive testing program to design a single safety subsystem for one vehicle model within a single year.

Nevertheless, with far more limited resources, private entrepreneurs have developed promising propeller guard designs which have reduced top end speed by only ten percent or less. Boat handling with these guards has

been characterized as at least acceptable if not improved. The potential for improvement upon these results by a committed manufacturer is evident.

Further, it has been understood in other contexts that some trade-offs between performance and safety must be considered acceptable for a product capable of causing serious injury or death. For example, emission control devices for automobiles may result in hard starting and decreased fuel economy but the environmental and human health benefits have been deemed worth these costs. (It is also interesting to note that automobile manufacturers were able to substantially overcome these fuel efficiency and cold starting problems, after conducting intensive research and development.)

Misconception: *Propeller guards would not offer increased protection to people in the water. Striking a propeller guard will produce serious or fatal injuries (substituting severe blunt trauma for lacerative injuries) and create the potential for limb entrapment.*

A propeller guard's ability to protect persons in the water will depend on the velocity of the boat at impact. Available data suggest that a significant number of propeller injuries occur at low or idling speeds. The engineering consensus appears to be that, at speeds up to approximately 10 to 12 mph, a cage-type propeller guard can prevent the serious limb injuries often associated with unguarded propellers. At higher speeds, the protective effect of a guard is less well documented. Additional properly designed and unbiased impact tests employing cadavers or anthropomorphic human surrogates are needed. No history of limb entrapment in a ring-shaped guard was located; a properly designed cage guard would eliminate this potential.

Misconception: *By significantly enlarging the underwater profile of the boat/motor combination, guards increase the overall likelihood of being struck.*

The total area which the propulsion unit occupies in the water will, in fact, be increased by the inclusion of any device surrounding the propeller. For most, if not all, of the devices that have been developed, however, this does not amount to a "significant" increase. In most cases, someone who contacts the guard would have been struck by the propeller in the absence of a guard. Furthermore, some tradeoff between marginally increased risk of injury and greatly reduced severity of injury is appropriate and beneficial.

Misconception: *There is no consumer demand for propeller guards. Propeller guards would significantly increase the cost of a marine engine.*

There are very few data concerning the actual or anticipated consumer demand for propeller guards. Mercury Marine has admitted that it has never explored its customers' potential interest and attitudes towards propeller guards in any formal marketing study. (No such study conducted by any other marine engine manufacturer was discovered.)

Without appropriate consumer education, marketing and promotion by manufacturers, no reliable conclusions regarding the level of consumer acceptance of propeller guards can be drawn. It is instructive to note, however, that after General Motors first offered air bags on several of its 1974 model cars, it subsequently claimed that there was little demand for the safety device. Yet, as it turned out, GM and its dealers had actively discouraged sales of

this expensive option. [Kelley, 1980] Moreover, confidential GM studies showed a high potential demand for air bags once consumers were educated about their safety benefits. Today, the cost of air bags has declined, they are actively marketed by auto manufacturers and are readily accepted – even demanded – by many consumers. Like air bags, consumer acceptance of propeller guards may be largely manufacturer-driven. Also like air bags, implementation of propeller guards as original equipment can be expected to reduce overall societal costs associated with an often preventable injury.

There is also no reliable information on the increased cost associated with a standard equipment propeller guard, precisely because manufacturers have never seriously attempted to develop or market one. Propeller guards developed and manufactured by small entrepreneurs have been sold for approximately $125. [Chadwell, 1992] Economies of scale associated with mass production would be expected to significantly reduce this cost. Furthermore, propeller guards capable of protecting persons in the water could also provide some protection against propeller damage caused by underwater objects. By reducing the need for the purchase of a replacement propeller, the net cost of the guard to the consumer would be further reduced.

Part Five

Recommendations

If the public health problem of propeller injuries is to be properly addressed, the Coast Guard, marine engine manufacturers, the U.S. civil justice system, and state

government representatives must undertake a series of affirmative actions. These actions are summarized in the recommendations to follow. Their overall goals are to:

- ✦ Generate an improved and unbiased assessment of the scope and magnitude of propeller injuries;
- ✦ Heighten consumer awareness of the dangers associated with unguarded propellers and provide appropriate compensation for injured persons; and
- ✦ Require or encourage the development, testing and implementation of feasible counter-measures to prevent propeller injuries.

United States Coast Guard

✦ In its annual reporting and analysis of U.S. boating injury data, the Coast Guard (following the Red Cross's lead in its recent survey) should establish a separate category for "struck by propeller" incidents to enable improved understanding of the propeller injury problem.

✦ In its annual reporting and analysis of U.S. boating injury data, the Coast Guard should identify all propeller injuries, whether or not the propeller strike was the first or a later event in an injury-producing sequence.

✦ The Coast Guard should improve the reporting rate for non-fatal injuries (rather than simply conceding that the reporting rate for non-fatal injuries is 10 percent or less). This may be accomplished through active and effective methods for injury surveillance such as hospital

emergency room and discharge data or physician questionnaires, or at least by increased publicity and enforcement of the existing reporting requirements.

✦ The Coast Guard should reverse its acceptance of the findings and recommendations of the NBSAC propeller guard subcommittee because of the subcommittee's reliance upon incomplete data on the incidence, severity and prevention of propeller injuries.

✦ After gathering and analyzing improved propeller injury data (including data generated by the Red Cross and upcoming reports), the Coast Guard should reassess the feasibility and desirability of propeller guards. The Coast Guard might be guided in this endeavor by the recommendations of its own staff and consultants, including the recommendations contained in reports by Freund, Traub and Purcell.

Manufacturers

Any manufacturer who places a product capable of causing harm into the stream of commerce has an obligation to its users to make it as safe as reasonably possible without preventing the product from functioning as intended. For recreational boat engine manufacturers, this means at a minimum:

- ✦ Actively monitoring and reporting the incidence and severity of propeller injuries caused by their products;
- ✦ Engaging in appropriately funded and targeted research and development to explore ways to reduce or eliminate propeller injuries; and

- Providing adequate warnings and consumer information concerning the threat posed by unguarded propellers.

Litigation

- The U.S. civil justice system should allow juries (assisted by expert testimony) to reach decisions regarding the potentially defective character of unguarded propellers as well as the feasibility of countermeasures to prevent propeller injuries. This policy will allow appropriate compensation for victims of propeller-related injuries (by shifting the cost of those injuries to manufacturers, the group best able to insure against the costs and to reduce the potential for costly injuries in the first place) and will provide manufacturers with enhanced incentive for product modification.

Congress

- If the Coast Guard does not adequately respond to the recommendations contained in this report, Congress should consider exercising its oversight function to hold public hearings addressing regulatory solutions to prevent propeller injuries.

State Action

- In the absence of an effective strategy by the federal government or manufacturers to reduce the incidence and severity of propeller injuries, state legislatures should draft and enact appropriate legislation (within the

confines of federal preemption) to require counter-measures such as propeller guards.

- To the extent possible, given limited resources, state and local public health departments should assess the incidence and severity of the propeller injury problem within their jurisdictions. Where appropriate, these agencies should sensitize their constituencies as to the dangers associated with unguarded propellers and to the feasibility of making propellers safer.

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